WAM+©

Introduction

The Calculators

Reference

Information

Glossary

A

B

C

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Acre (a.)

A unit of land measure equal to 43,560 square feet or 1/640 square mile.
See Area.

Adjacent Side

The side of a triangle ***next to*** a given angle. In the diagram below, Side b is ***adjacent*** to Angle A.
Notice that while Side c is **also** next to angle A in the right triangle it is known instead as the hypotenuse.
See also Opposite Side & Trigonometry.

Avoirdupois Weight (av., avoir., avdp.)

The U.S. and British system of weights for goods ***other than*** gems, precious metals, and drugs.
27-11/32 grains = 1 dram. 16 drams = 1 ounce. 16 ounces = 1 pound.
The grain is the only unit of weight common to all systems.
See also Apothecaries' Weight, and Troy Weight.

Close Glossary

Barrels (bbl., bl.)

In the United States the liquid barrel varies from 31 to 42 gallons. Many state laws fix the liquid barrel at 31.5 gallons (which is half a hogshead). Federal taxes on fermented liquors (beer, for instance) are based on a 31-gallon barrel, and Federal taxes on proof spirits (bourbon, for example) are based on a 40-gallon barrel. Wine barrels, however, are 31.5 gallons. For petroleum products, the standard unit is the 42-gallon barrel.

The U.S. dry barrel of 7056 cubic inches is the standard for fruits, vegetables and other commodities except cranberries. The cranberry barrel is set at 5826 cubic inches.

Bushel (bu., bsh.)

A unit of dry measure equivalent to 4 pecks or 32 dry quarts.
Also see the main topic volume.

Calendar (cal.)

Calendar divisions are based on the movements of the earth and the regular appearances of the sun (solar) and the moon (lunar).
The mean calendar month is based on the calendar year which, in turn, is based on the mean solar day.

Celsius (C.)

A temperature scale named for the 18th-century Swedish astronomer Anders Celsius (1701-1744). On the Celsius scale, the freezing point of water is 0ºC and the boiling point is 100ºC. The Celsius scale is identical to the centigrade scale.

See also Fahrenheit, Kelvin, and Temperature.

centi-

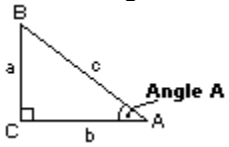
Symbol, **c**. A metric prefix indicating **one hundredth** (10^{-2}); for example, centimeter.

Sidereal Year

The time required for one complete revolution of the earth about the sun, *relative to the fixed stars* or 365 days, 6 hours, 9 minutes, 9.54 seconds of mean solar time.
See also Calendar Year, Leap Year, Solar Year, and Time.

Cosine (cos.)

The cosine of an angle in a right triangle is the ratio of the adjacent side over the hypotenuse.
In the triangle shown below, cos A = b/c



See also Sine, Tangent, Trigonometry.

deci-

Symbol, **d**. A metric prefix indicating **one tenth** (10^{-1}); for example, decibel.

deka-

Also **deca**. Symbol, da. A metric prefix indicating **ten** (10^1); for example, decathalon.

Fahrenheit (F.)

A temperature scale in which the freezing/melting point of water is 32º F and the boiling point is 212º F..Developed by the German physicist Gabriel Fahrenheit (1686-1736).
See also Celsius, Kelvin, & Temperature.

Fathom (fath., fm.)

A unit of length or depth equal to six feet. Used chiefly in nautical and mining measurements.

Furlong (fur.)

A unit of distance, used chiefly in horse racing, equal to 220 yards or 1/8 statute mile. Originally the **length** of a **fur**row made on a square field of 10 acres.

Gill (gi.)

A unit of liquid measure equal to 1/4 pint or 4 fluid ounces.
Pronounced "Jill".
Also see the main topic volume.

Hectare (ha.)

A metric system unit of area equal to 100 **ares**. An are is equal to 100 square meters or 119.599 square yards.

Hogshead (hhd.)

A unit of liquid measurement equal to 63 liquid gallons or two 31.5 gallon barrels.

Hypotenuse

The side of a right triangle opposite the right angle. See also Opposite Side, Adjacent Side, & Trigonometry.

Kelvin (K.)

A basic SI unit of temperature, the Kelvin or absolute scale was invented by the British mathematician and physicist William Thomson, 1st Baron Kelvin (1824-1907). Zero degrees Kelvin (0º K) is known as absolute zero and corresponds to -273.16º C or -459.69º F. The degree intervals on the Kelvin scale are identical to those measured on the Celsius scale but they have a different zero point. The Kelvin scale is used chiefly for scientific work.

See also Celsius, Fahrenheit, and Temperature.

kilo-

Symbol, **k**. A metric prefix indicating **one thousand** (10^3); for example, kilometer.

Knot (kn.)

A unit of speed equal to one nautical mile per hour.

Liter (l., lit.)

A basic unit of volume in the metric system, the liter (or litre) is equal to exactly one cubic decimeter.

The liter has a long and checkered past.
It dates from the French Revolution and is named for the pre-revolutionary unit of volume the *litron*.
It was originally designated as the volume occupied by a kilogram of water at 4ºC at a pressure of 760mm of mercury (one atmosphere), and was supposed to be the same volume as a cubic decimeter. It was subsequently discovered that this kilogram of water differed from a cubic decimeter by 28 parts per million.
In 1901 the International Weights and Measures Congress confirmed the liter as being 1.000028 cubic decimeters. This made the cubic meter equal to 999.972 liters instead of 1000 liters as it is today.

In 1964 the liter was redefined to be equal to exactly equal to one cubic decimeter.

Lunar

Of or pertaining to the moon. See lunar month.

Mean

Average.

Mile, Statute (mi.)

A unit of distance on land in English speaking countries equal to 5,280 feet, or 1760 yards or 1,609.344 meters.
The square mile (mi²) is a standard unit of area measure.

Mile, Nautical (nm., n.m.)

The international nautical mile, also known as the international air mile, is a unit of distance equal to 1.852 kilometers, or 6076.1033 feet.
Also see Knot.

milli-

Symbol, **m**. A metric prefix indicating **one thousandth** (10^{-3}); for example, milliampere.

Millihelen (mH.)
The amount of beauty required to launch one ship.
See Troy

Opposite Side

The side of a triangle ***opposite to*** a given angle. In the diagram below, Side a is ***opposite*** to Angle A.
See also Adjacent Side, Hypotenuse, & Trigonometry.

Peck (pk.)

A unit of dry measure equal to 4 quarts or 1/4 bushel.
Also see the main topic Volume.

Pica

A printer's unit or type size equal to 12 printers points or 0.166044 (nearly 1/6) of an inch in length.

Printer's Point

A unit of type size equaling 0.013837 (a little less than 1/72) inches, or 1/12 pica in length.

Rod (rd., r.)

A linear measure of length used chiefly in surveying.equal to 5-1/2 yards, 16-1/2 feet, or 5.0292 meters.
Also see the main topic Length / Distance.

Scruple (sc., scr.)

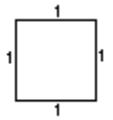
A unit of weight in the apothecaries' system equal to 20 grains, 1/24 of an apothecary or troy ounce, or 1/288 of an apothecary or troy pound.

Sidereal Time

Sidereal (pronounced sid dear´ ee al) means pertaining to the stars.
Sidereal time is time based on the axial and orbital rotation of the earth with reference to the **background of stars**.
A sidereal day is roughly 4 minutes shorter than a mean solar day.
See also solar time, and the main topic Time.

Square Measure

A system of units used in measuring area. The exponent ^{2} is often used to indicate square measure as in m^2 for square meters or ft^2 for square feet.
See Cubic Measure.



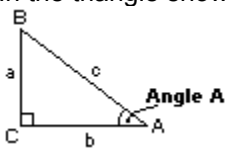
1 Square Unit

Mean Solar Year

Also known as a **tropical** year.
The time interval between two successive passages of the sun through the vernal equinox.
It is 365.24219329 mean solar days or 365 days, 5 hours, 48 minutes, and 45.5 seconds.
See also Calendar Year, Leap Year, Sidereal Year, and Time.

Tangent (tan)

The tangent of an angle in a right triangle is the ratio of the opposite side over the adjacent side.
In the triangle shown below, tan A = a/b



See also Sine, Cosine, Trigonometry.

Trigonometry

The branch of mathematics that deals with the relations between the sides and angles of triangles. The Trigonometry module of WAM+ concerns itself with the most common form of trigonometry, i.e. the trigonometry of right triangles.

See also: Sine, Cosine, Tangent, Opposite Side, Adjacent Side, and Trigonometry Calculator.

Troy Weight (t.)

A system of weights in use for precious metals and gems (formerly also for bread, grain, etc.).
24 grains = 1 pennyweight. 20 pennyweights = 1 ounce. 12 ounces = 1 pound.
The grain, ounce and pound are the same as in apothecaries' weight, the grain alone being the same as in avoirdupois weight. The troy pound is no longer a standard weight in Great Britain.

Apothecaries' Weight (ap. , apoth.)

A system of weights used by druggists and pharmacists when compounding medicines. The modern trend for them is to use the metric system.

Most units in the apothecaries' system are the same as troy weights. The scruple is the only unit of measure unique to the apothecaries' system.

See also Avoirdupois Weight, and Troy Weight.

Grain (gr.)

The smallest unit of weight in most systems; originally determined by the weight of a plump grain of wheat. In the U.S. and British systems, as in avoirdupois, troy, and apothecaries' weights, the grain is identical. In an avoirdupois ounce there are 437.5 grains; in the troy and apothecaries' ounces there are 480 grains. See also ounce.

Gram (g.)

A metric unit of mass or weight equal to 15.432 grains. One thousandth of a kilogram.

Pennyweight (dwt., pwt.)

A unit of weight in the troy system equal to 24 grains, 1/20 of a troy ounce, or 1.55517384 grams.

Right Triangle

A triangle having a right angle as one of its angles. See also Trigonometry.

Right Angle

An angle of exactly 90 degrees. A small square at the vertex is often used to indicate a right angle.
See also Right Triangle, Trigonometry, Angular Measure.

tera-

Symbol, **T**. A metric prefix indicating **one trillion** (10^{12}); for example, teravolt.

Close Glossary

Leap Year

The mean solar year is *approximately* 365.25 mean solar days. That is 0.25 or 1/4 day longer than the calendar year. To compensate for the difference, an extra day, February 29th, is added to the calendar year in every year evenly divisible by 4. (Well, almost. See below.)
This 366 day year is known as a **leap year**.

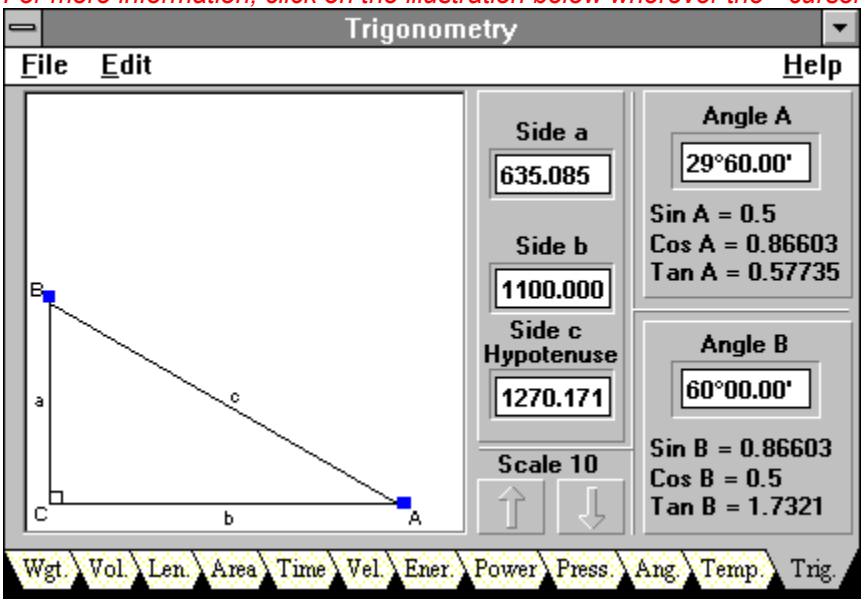
If we made 1 year out of every 4 a leap year, we would have 100 leap years in every 400. This would be fine if the mean solar year actually **was** 365.25 or 365-**100/400** days long. But in reality it is a tiny bit shorter, i.e. 365.24219 days long. Now 365.24219 is very close to 365.24250 which is 365-**97/400**. So if we could knock off 3 of those 100 leap years to get 97 leap years out of every 400, our calendar years would be much more accurate.

This, then, was the problem that faced Pope Gregory XIII (1502-1585), the creator of the Gregorian calendar. His solution was to make *every century year **not** evenly divisible by 400* a normal year . The year 1600 was a leap year, since it is evenly divisible by 400, but 1700, 1800, & 1900 were **not** leap years because, even though they are divisible by 4, they are not evenly divisible by 400. The year 2000 will be a leap year again. By this method, 3 of the possible 100 leap years in every 400 are eliminated leaving 97.

Trigonometry

Trigonometry is the branch of mathematics that deals with the solutions of triangles by considering the relationships between their sides and angles. The Trigonometry module of WAM+ concerns itself with the most common form of trigonometry, i.e. the trigonometry of right triangles.

For more information, click on the illustration below wherever the cursor appears .



For a **brief review** of trigonometry Click Here

To see some **solved problems** Click Here

See also:

Entering A Hypotenuse

Entering Angles

The Unit Conversion Calculators

Scientific Notation

A standardized method for expressing very large or very small numbers by writing them as a number multiplied by a power of 10. Also known as *normalized exponential form.*
Computers use the letters **'E'** or **'e'** after a decimal number to indicate scientific notation.

For a simple explanation of scientific notation click here.

nano-

Symbol, **n**. A metric prefix indicating **one billionth** (10^{-9}); for example, nanosecond.

The "**^**" symbol, also known as a carat, indicates "to the power of", e.g **10^3** equals $\mathbf{10^3}$ or ten to the third power, which is 1000, while **10^-2** equals $\mathbf{10^{-2}}$ or "ten to the minus two" which is $1/10^2$ or 1/100.
The carat notation is usually used when superscripts are unavailable or difficult to use such as on computers with only the standard character sets.
See also Scientific Notation.

Dram (dr.)

The dram, like the ounce, is a confusing term as it is a unit in three different weight systems (avoirdupois, troy and apothecaries') as well as a unit of volume (fluid drams).

The **avoirdupois** dram is a unit of weight equal to 27-11/32 grains or 1/16 avoirdupois ounce

The **troy** or **apothecaries'**[1] dram is a unit of weight equal to 60 grains or 1/8 troy ounce.

The **fluid dram** (fl dr) is a unit of volume equal to 1/8 fluid ounce.

[1]The apothecaries' dram is the same as the troy dram.

Ounce (oz.)

The ounce, like the dram, is a confusing term as it is a unit in three different weight systems (avoirdupois, troy, and apothecaries') as well as a unit of volume (fluid ounces).
The **avoirdupois** ounce is a unit of weight equal to 16 avoirdupois drams or 437.5 grains. There are 16 avoirdupois ounces in an avoirdupois pound.
The **troy** or **apothecaries'** ounce is a unit of weight equal to 8 troy drams or 480 grains. There are 12 troy ounces in a troy pound.

The **fluid** ounce (fl oz) is a unit of volume equal to 8 fluid drams.

Don't ask.

Light year (lt.-yr.)

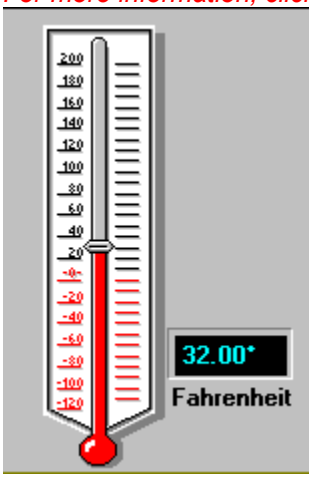
A unit of distance (not time) equal to the distance traversed by light, which travels at 186,000 miles per second, in one mean solar year, approximately 5,878,510,000,000 miles.

Centigrade (C.)

The old name for the temperature scale now known as Celsius.

Temperature

For more information, click on the illustration below wherever the cursor appears .



Scales

Scales supported are: Fahrenheit, Celsius, & Kelvin.

Mouse

Click on the slider and drag it up and down to change temperature.
Click on the "tube" above the slider to raise the temperature by 10º.
Click on the "tube" below the slider to lower the temperature by 10º.
Clicking on the rulers on either side moves the slider to the *approximate* location of the mouse cursor.

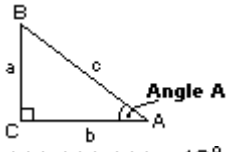
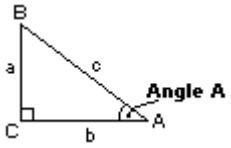
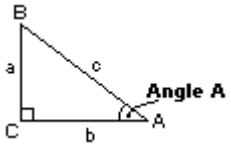
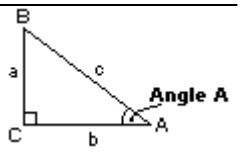
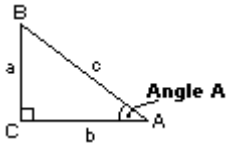
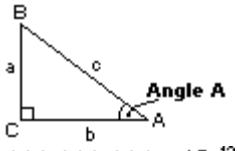
Keyboard

To adjust a thermometer with the keyboard press the <Tab> or <Enter> key until the slider you wish to adjust "blinks".
Tap the up or down arrow keys to adjust the temperature by 1º
Hold the up or down arrow keys and the slider will slide up or down.
The <Page Up > key increases temperature by 10º
The <Page Down > key decreases temperature by 10º

The "Readout" Box

You may also enter temperatures directly into the "readout" boxes. Just click in a box, or <Tab> to it, and enter the temperature as a decimal. The degree symbol (**º**) will be added automatically.
You may enter **any temperature you wish** in a box and it will be converted to the other scales. You are **not** limited by the range of the graphic thermometers. Temperatures below absolute zero, however, will produce an error message.

Metric Prefixes

Prefix	Symbol	Multiplier	Term	Example
exa	E	1 000 000 000 000 000 000 = 10^{18}	quintillions	N.A.
peta	P	1 000 000 000 000 000 = 10^{15}	quadrillions	N.A.
tera	T	1 000 000 000 000 =	trillions	teravolts
				
giga	G	1 000 000 000 = 10^{9}	billions	gigabyte
mega	M	1 000 000 =	millions	megahertz
kilo	k		thousands	kilometer
		1 000 =		
hecto	h		hundreds	hectogram
		100 =		
deca (deka)	da	10 = 10^{1}	tens	decathalon
deci	d		tenths	decibel
		0.1 =		
centi	c	0.01 = 10^{-2}	hundredths	centimeter
milli	m		thousandths	milliampere
		0.001 =		
micro	μ	0.000 001 =	millionths	microbar
nano	n	0.000 000 001 =	billionths	nanosecond
				
pico	p	0.000 000 000 001 = 10^{-12}	trillionths	picofarad
femto	f	0.000 000 000 000 001 =	quadrillionths	N.A.
atto	a	0.000 000 000 000 000 001 =	quintillionths	N.A.

Ambiguities and exceptions:

Some prefixes are ambiguous. "Centi", for example, comes from the Latin for both "hundredth" and "hundred". So while we have "centimeter", meaning a hundredth of a meter, we also have "centipede" meaning a bug with a hundred legs. Millipedes have the same problem.

A different kind of ambiguity exists with the prefix "micro". In terms of the metric system micro has an exact meaning, i.e. one millionth. But "micro" also means, simply, "very small". A microscope is not a "millionth of a scope" nor is a microcomputer a "millionth of a computer". A microsecond, though, ***is*** a millionth of a second.

Micro is the only prefix that has a greek letter, μ (mu), as its symbol.

A millionth of a meter is known as both a *micrometer* and a *micron.*

Note:

The prefixes exa, peta, tera, deca (also deka), deci, hecto, femto, and atto are not commonly used. Of these, WAM+ only deals with hectares, an area measurement. In the metric system it is easy to convert from one prefix to another by multiplying or dividing by a power of ten or simply by moving the decimal point.

Also see Scientific Notation.

Teravolt (Tv.)

A volt is a unit of electrical pressure. It is named after the Italian physicist Count Alessandro Volta.
A **tera**volt is a **trillion** volts. A trillion is a thousand billion.
It could be said, then, that at the present time the national debt is about four terabucks.

Gigabyte

On a computer, a byte is a unit of information equaling 8 bits. It takes one byte to represent a single character such as a letter or number. A **giga**byte equals **one billion** bytes.

Scientific Notation

If a number is very large or very small, WAM+ will display it in scientific notation. *You do not need to know anything about math or science* to expand a number written in scientific notation.

The simple explanation:

Computers use the letters **"E"** or **"e"** after a decimal number to indicate scientific notation. It is a standardized method for expressing very large or very small numbers.
To "expand" a number in scientific notation, just move the decimal point the number of places indicated after the "**e**", in the direction indicated by the sign, and add any necessary zeros along the way.
"+" means move the decimal to the **right**. **"-"** is to the **left**.
Here are some examples:

2.3456789e+05 equals **234567.89** The decimal point was moved **5** places to the **right**.
6.25e+09 equals **6250000000.0** The decimal point was moved **9** places to the **right**.
1.382e-12 equals **0.000000000001382** The decimal point was moved **12** places to the **left**.

That's all you need to know to understand the output of this program. For a more in-depth explanation of scientific notation, see below.

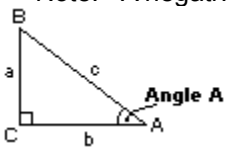
A fuller explanation:

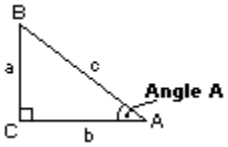
Scientific notation (SN) is a standardized method for expressing very large or very small numbers by writing them as a number **multiplied by a power of 10**. It is also known as *normalized exponential form.* The "e" stands for "exponent" and the number following it is the power to which 10 is to be raised. The "e" character is used on computers since they are not very adept at exponents or superscripts. The way SN is written in the "real world" is by showing a number as being multiplied by a power of 10. Thus the written or printed SN number **1.2345 x** would be displayed on a computer as **1.2345e-12**.
An important part of the SN standard is that the decimal point always appears *directly after the first non-zero digit*.

Using the examples above:

2.3456789e+05 is a computer"s way of writing **2.3456789 x** which stands for **2.3456789 x 10x10x10x10x10** or **2.3456789 x 100000** or **234567.89**
6.25e+09 means **6.25 x** which equals **6.25 x 1000000000** or **6250000000.0**
1.382e-12 means **1.382 x** which equals **1.382 x 1/1000000000000** or **0.000000000001382**

Note: A negative exponent means a reciprocal exponent or $1/10^n$, e.g.



= 1/


or 1/1000.

Megahertz (Mhz.)

A hertz (hz.) is a unit of frequency meaning cycles per second. The term "cycles per second" was renamed to "hertz" in honor of the German scientist Heinrich Rudolph Hertz (1857-1894). The term cycles per second (cps) can still be found in old electronics books, and old radio dials are calibrated in **mega**cycles and kilocycles.

An FM radio station operating at 107.9 on the dial, for instance, is transmitting on the frequency of 107.9 **mega**hertz or 107.9 **million** cycles per second.

Kilometer (km.)

A basic unit of length in the metric system equal to **one thousand** meters.
The square kilometer (km²) is a common unit of area.

Decathalon

A **deca**thalon is a track-and-field contest comprised of **ten** separate events.

Hectogram (hg.)

A **hecto**gram is **one hundred** grams.

Decibel (db.)

A **deci**bel is equal to **one tenth** of a bel. Bels are a unit of power ratio named after Alexander Graham Bell.
Decibels are most often used in the measurement of sound intensity.

Centimeter (cm.)

The meter is a basic unit of length in the metric system. A **centi**meter is **one hundredth** of a meter.
The square centimeter (cm^2) is a common unit of area.
The cubic centimeter (cc.) is a common unit of volume often used to measure liquids. Same as a milliliter.

Milliampere (mA)

The ampere is the basic unit of electrical current. A **milli**ampere is **one thousandth** of an ampere. The current produced by those little black power supplies that you plug into the wall is usually somewhere between 50mA and 750mA.

Nanosecond (ns., nsec.)

A **nano**second is **one billionth** of a second. It takes 60 to 80 nanoseconds for the RAM chips in this computer to refresh their data.

Picofarad (pf.)

A farad, named after the British physicist Michael Faraday (1791-1867), is a unit of electrical capacitance.
A **pico**farad , also known as a micro-micro farad (μμf), is equal to **one trillionth** of a farad.

Day, Mean Solar

A day is the period of time required for one rotation of the earth, on its axis.
The solar day is measured by the interval between two successive meridian passages of the sun. It varies in length because of the variation in speed of the earth in its orbit. Because of this *the length of the solar day is averaged over the period of a year* and is referred to as the **mean solar day.**
It is roughly 4 minutes longer than the sidereal day.
The mean solar day is divided into 24 equal mean solar hours.
Also see the main topic Time.

Pound (lb.)

The avoirdupois pound is a unit of weight equal to 16 avoirdupois ounces or 7,000 grains.
The troy or apothecaries' pound is a unit of weight equal to 12 troy ounces or 5760 grains.

Slider Knob

To adjust the slider, just click and drag it with the mouse cursor. If the slider is "blinking" on and off you may adjust it with the keyboard.

Dry measure

The system of units of capacity, or volume, used in measuring dry commodities such as grain or fruit, e.g. a quart of strawberries or a bushel of potatoes.

Liquid Measure

The system of units of capacity, or volume, used in measuring **fluids** such as milk, oil, etc.
4 gills=1 pint. 2 pints=1 quart. 4 quarts=1 gallon. 63 gallons=1 hogshead.

Pint (p., pt.)

A **liquid** pint equals 1/2 liquid quart, 28.875 (28-7/8) cubic inches, or 473.176 cubic centimeters (cc.'s).
A **dry** pint equals 1/2 dry quart, 33.6003125 cubic inches, or 550.61047 cc.'s.
Also see the main topic volume.

Quart (qt.)

A **liquid** quart is a unit of liquid measure equal to 57.75 cubic inches, 32 fluid ounces, 1/4 liquid gallons, or 946.35 cubic centimeters (cc.'s).
A **dry** quart is a unit of dry measure equal to 1/4 dry gallons, 1/32 bushel or 1101.22 cc.'s.
Also see the main topic volume.

Gallon (gal.)

A **liquid** gallon is a unit of liquid measure equal to 231 cubic inches, 128 fluid ounces, or 4 liquid quarts.
An **imperial** or **British** (Brit.) gallon is a unit of liquid measure equal to approx. 1-1/5 U.S. Gallons (1.200949 to be exact).
A **dry** gallon is a unit of dry measure equal to 4 dry quarts or 1/8 bushel.
Also see the main topic volume.

Absolute Zero

The complete absence of heat. No molecular motion. The lowest temperature theoretically possible in the universe.
Absolute zero is approximately -273.16º C (-459.69º F) or zero degrees on the Kelvin scale (0ºK).

pico-

Symbol, **p**. A metric prefix indicating **one trillionth** (); for example, picofarad.

Cheval-Vapeur

Same as metric horsepower.

Foot (ft., ')

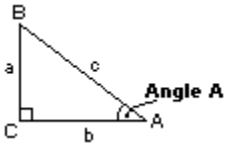
A unit of length in the U.S. and British systems equal to 12 inches or 1/3 yard.
The square foot (ft^2) is a common unit of area.
The cubic foot (ft^3) is a common unit of volume.

Inch (in., ")

A unit of length in the U.S. and British systems equal to 1/12 of a foot.
The square inch (in^2) is a common unit of area.
The cubic inch (in^3) is a common unit of volume .

Yard (yd.)

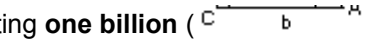
A unit of length in the U.S. and British systems equal to 3 feet, 36 inches, or 0.9144 meters.
The square yard (yd^2) is a common unit of area.
The cubic yard (yd^3) is a common unit of volume.



The Meter (m.)

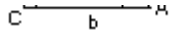
The fundamental unit of the metric system.
In 1790, before it was known that the earth is not perfectly spherical, the meter was defined as one ten-millionth of the earth's quadrant passing through Paris, France.
From 1889 to 1960 it was defined as the distance between two lines on a platinum-iridium bar. Known as the "International Prototype Meter" it is preserved at the International Bureau of Weights and Measures near Paris.
In 1960 it was redefined as the length equal to 1,650,763.73 wavelengths in a vacuum of the orange-red radiation of krypton 86.
The most recent redefinition of the meter was in 1983 when it was defined as the length of the path traveled by light in a vacuum in 1/299,792,458 of a second.

The square meter (m^2) is a common unit of area.
The cubic meter (m^3) is a common unit of volume and is also known as a kiloliter.

giga-
Symbol, **G**. A metric prefix indicating **one billion** (); for example, gigabyte.

mega-
Symbol, **M**. A metric prefix indicating **one million** ( ); for example, megahertz.

hecto-

Symbol, **h**. A metric prefix indicating **one hundred** (); for example, hectogram.

Bit

The smallest amount of information possible on a computer. A bit has only two states which are referred to as 1 or 0, on or off, true or false, high or low, yes or no, etc. Bits are usually more useful when grouped together in groups of eight known as bytes.

micro-
Symbol, μ A metric prefix indicating **one millionth** ( ); for example, microbar.

Solar
Pertaining to the sun.

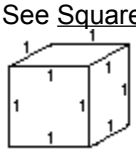
Solar Time

Solar time is measured by the apparent motion of the sun across the sky. When the sun reaches the meridian at any given point on the earth it is noon. A solar day is the interval between two successive meridian passes of the sun.

See also Sidereal Time, Mean Solar Day, Time.

Cubic Measure

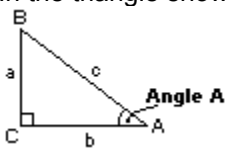
A system of units used to measure volume or capacity. The exponent ^{3} is often used to indicate cubic measure as in cm^3 for cubic centimeters or in^3 for cubic inches.
See Square Measure.



1 Cubic Unit

Sine (sin)

The sine of an angle in a right triangle is the ratio of the opposite side over the hypotenuse.
In the triangle shown below, sin A = a/c



See also Cosine, Tangent, Trigonometry.

Decimal

A decimal is a way of representing rational numbers such as fractions and mixed numbers, or irrational numbers like π.

For a more thorough discussion of decimals, click here.

Integer

A whole number as distinguished from a fraction or a decimal number.

Fraction

Fractions represent parts of a whole. The fraction 3/4 indicates three out of four equal parts.
A fraction indicates a division; 3/4 is a way of saying 3 ÷ 4.
Another way of representing this division is known as a *decimal fraction*, e.g. 3/4=.75.

The number before or above the bar is known as the numerator and the number after or below the bar is the denominator.
In the above example, 3 is the numerator and 4 is the denominator.
If the numerator is greater than the denominator the result is called an *improper fraction* and is a fractional representation of a mixed number, e.g. the improper fraction 3/2 = 1-1/2 or 1.5.

Mixed Number

A number consisting of an integer and a fraction or decimal fraction such as 2-5/8 or 2.625.

Decimals

A decimal is a way of representing rational numbers, such as fractions and mixed numbers, or irrational numbers like .

The decimal representation of any rational number or any fraction either *terminates* or is *periodic*.

A **terminating** decimal is one that eventually comes to a finite end such as 0.625 (5/8) or 3.494252873563218 (3-43/87).

By a **periodic** or **repeating** decimal we mean one like 2.6333333...(2-19/30) in which the 3 is repeated infinitely, or 0.378378378378...(14/37) in which the block 378 is repeated infinitely. The fraction 1/7 (0.142857142...) is a periodic decimal in which the sequence 142857 is repeated infinitely. Computers often round off the last number of a repeating decimal. Thus 2/3 is usually represented as .666666667

An **irrational** number does not terminate and has *no periodicity*. A classic example is the number π which has been calculated to millions of places by modern computers. Irrational numbers cannot be represented by fractions.

Rational Number

Any number capable of being expressed by an integer, (e.g. 8, 27, 65536) or in fractional form as a quotient of integers (e.g. 3/5, 13/27, 23/5, 4/1, etc.) .
See also, Irrational Number, Decimals.

Irrational Number

Any real number that is **not** capable of being expressed exactly by an integer, or a fraction.
An example is (1.414213562373.....) which is a non-terminating, non-repeating decimal that extends infinitely
See also Rational Numbers

Ton

A **short ton (t.)** also called a "net ton" is an avoirdupois unit of weight equal to 2,000 pounds. This is the ton usually referred to when we simply say "ton".

A **long ton (t.)** is an avoirdupois unit of weight equal to 2,240 pounds.

A **metric ton (m.t., M.T.)** is a metric unit of mass equal to 1,000 kilograms.

Year , Calendar (yr.)

A period of 365 or 366 mean solar days on the Gregorian calendar.
The 366 day year is known as a leap year.
See also Mean Solar Year, Sidereal Year, and Time.

Hour (hr.)

The sidereal day is divided into 24 equal **sidereal hours**.
The mean solar day is divided into 24 equal **mean solar hours**.
Also see the main topic Time.

Day, Sidereal

The time required for a complete rotation of the earth, measured as the interval between two successive meridian transits of the vernal equinox. It is roughly 4 min shorter than the mean solar day.
The sidereal day is divided into 24 equal sidereal hours.
Also see the main topic Time.

Milliliter (ml.)

A unit of volume in the metric system equal to one thousandth of a liter. or one cubic centimeter (cc.).

Week, Mean calendar (wk.)

A mean calendar week is an interval of time equal to 7 mean solar days.
Also see the main topic Time.

Month, mean calendar

A mean calendar month is an interval of time equal to 1/12 (0.083333...) calendar years.
See also Lunar Month, and Time.

Month, Lunar

The mean, or average, time between successive new or full moons; equal to 29.530588 mean solar days, or 29 days, 12 hours, 44 minutes, 2.8 seconds. Also called the "synodic month".
See also Month, Mean calendar, and Time.

Minute (m.)

A unit of Time.
The sidereal minute is 1/60 of a sidereal hour.
The mean solar minute is 1/60 of a mean solar hour.
See also Minute of Arc

Second (s.)

The basic SI unit of Time.
The second was originally defined as 1/86400 of a mean solar day. Scientists discovered, however, that the rotation of the earth was not constant enough to serve as the basis of the time standard. As a result, the second was redefined in 1967 in terms of the resonant frequency of the cesium atom, i.e. the frequency at which this atom absorbs energy: 9,192,631,770 Hz.
The sidereal second is 1/60 of a sidereal minute and 1/3600 of a sidereal hour.
The mean solar second is 1/60 of a mean solar minute and 1/3600 of a sidereal hour.
See also Second of Arc.

Cup (c.)

A measure of volume, or capacity, equal to 1/2 pint, 8 fluid ounces, or 16 tablespoons.

Tablespoon (T., tbs., tbsp.)

A household cooking measure equal to 3 teaspoons, 4 liquid drams, or 1/2 fluid ounce.
Also see the main topic volume.

Teaspoon (t., tsp.)

A household cooking measure equal to 1/3 tablespoon, 1-1/3 liquid drams, or 1/6 fluid ounce.
Also see the main topic volume.

Readout Box

To enter data directly into this box, enter a decimal number and press <Tab> or <Enter>, e.g. to enter -350.5º just enter "-350.5" (without the quotes). You may enter **any temperature you wish** in this box. You are **not** limited by the range of the graphic thermometers. Temperatures below absolute zero, however, will produce an error message.

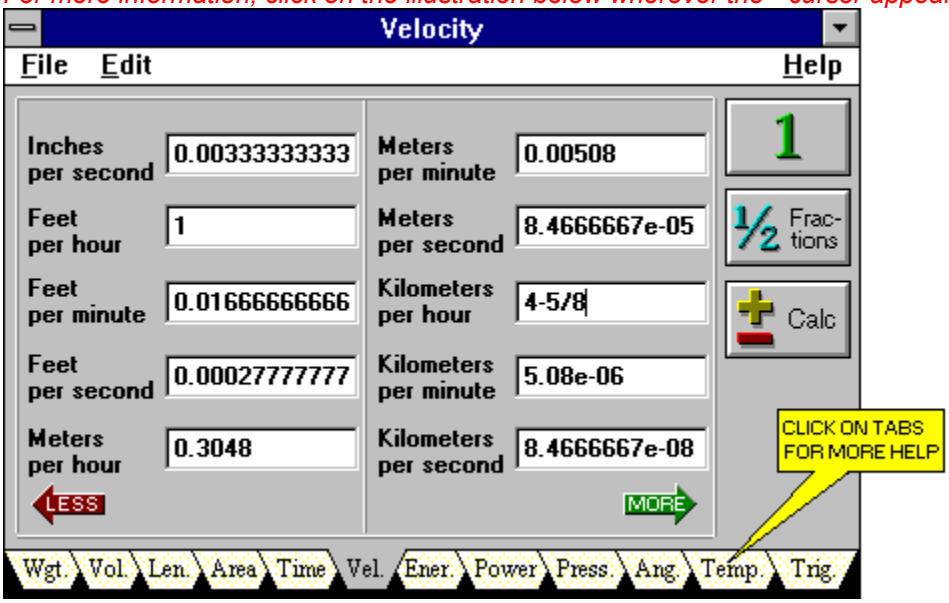
Frequently Asked Questions

The "+" is the Trigonometry calculator. Trigonometry does not normally fall into the category of "weights and measures" but it ***is*** a useful measuring tool and, as such, we thought it would make a useful addition to the program.
WAM+ also contains a decimal-to-fraction conversion utility, various tutorials, and several reference tables.

Unit Conversions

The unit conversion dialog boxes are easy to use. First select the category you want (weight, volume, etc.) by clicking on a tab. Then enter a value into any box and press <Enter> or <Tab>. All values will re-calculate automatically. If there is a MORE or LESS arrow you may click on it to reveal additional units of measurement. For specific information on a category, click on one of the tabs in the graphic below.

For more information, click on the illustration below wherever the cursor appears .



See also:

- Entering Numbers
- Scientific Notation
- Using Windows Calculator
- A Time Tutorial
- The Fraction Converter

They indicate scientific notation.

Tube

Clicking on the tube **above** the slider **raises** the temperature by 10º.
This corresponds to the <Page Up> key.

Clicking on the tube **below** the slider **lowers** the temperature by 10º.
This corresponds to the <Page Down> key.

Scale

Clicking on the scale causes the slider to move to the *approximate* location of the mouse cursor.

Please see the "barrels" entry in the glossary.

About WAM+

Weights **A**nd **M**easures Plus is a program for converting units of measurement from *one system to another*, such as yards to meters, or for conversions *within* a system of measurement, as in fluid ounces to gallons. A *decimal-to-fraction converter* and a *trigonometry calculator* are included.

WAM+ is for anyone who needs to convert one unit of measurement to another**:** students, cooks, engineers, desktop publishers, architects, CAD operators, photographers, rocket scientists, athletes, or anyone who just wants to see how many inches there are in a light-year or what 21.11º Celsius means in Fahrenheit.

An easy-to-use trigonometry calculator is included as an extra feature. It incorporates a dynamic right triangle that helps promote a better understanding of the relationships between the sides and angles of a right triangle.

WAM+ may be used by itself, or as an aid to learning about the metric system, decimals, fractions, or trigonometry. A table of metric prefixes, and brief tutorials on trigonometry are included. Additionally, there is information about decimals, fractions, and scientific notation. This program, however, is intended *only to enhance*, not replace, textbooks on weights and measures, or mathematics.

Please remember that this program is **not free**. If you are still using it after a reasonable trial period, you **must** pay for it. If you do not, you are stealing.

We thank you for trying WAM+ and we hope you find it useful.

Calc Button

This button runs the Windows Calculator, calc.exe. (Or any program you have in your WAM directory or your WINDOWS directory that is **named** "calc.exe")

Fractions Button

This button passes the number in the active box to the Fraction Converter for conversion to a fraction. It will also open the fraction converter if it is closed.

Repeating Decimal

This is a *repeating decimal* also known as a *periodic decimal*. See Decimals.
See also Entering Data.

Whole Number

This is a whole number or integer. It has no fractional component.
See also Entering Data

Terminating Decimal

A *terminating decimal* is a decimal which has a **finite end**, i.e. it does not extend infinitely like a repeating decimal or an irrational number. See Decimals.

See also Entering Data.

Scientific Notation

This number is in scientific notation. If you are unsure about what that is, please see the help topic.
See also Entering Data.

Less Arrow

If there is a Less Arrow there is another "page" of smaller units. Clicking on the arrow will shift that page into view.

More Arrow

If there is a More Arrow there is another "page" of larger units. Clicking on the arrow will shift that page into view.

Index Tabs

Click on the index tab of your choice for the category desired.

Contacting The Author

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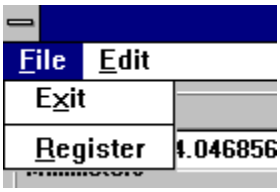
You may also contact us by E-Mail on CompuServe at 71550,217
From an Internet node send Mail to 71550.217@compuserve.com.

For pricing and registration information, please see how to order.
Thank you for your interest.

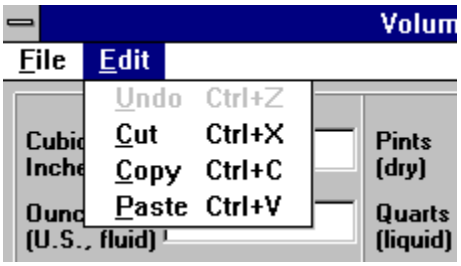
Gregory LeVasseur

File Menu



There are no files involved with WAM+ so the only command is **Exit.** If you have not registered, there will also be a **Register** command which will bring up the Registration dialog box. See also Shareware Information.

Edit Menu



The Edit menu in WAM+ functions in the usual manner: If an entry has been selected, the **Cut** and **Copy** commands will be enabled. The **Cut** command deletes the selection and moves it to the clipboard. The **Copy** command moves the selection to the clipboard but does not delete it. If there is data in the clipboard, the **Paste** command will be enabled and you may paste the data into any box. You may paste the data into any other Windows application including Windows' Calculator. You may also use the keyboard shortcuts shown instead of the pull down menu.

Using Windows Calculator

The button invokes the Windows calculator, calc.exe (or whatever program you have *named* calc.exe). You can pass data back and forth between WAM+ and Calculator by using the Edit Menus.

Here is an example. You might want to open WAM+ and try this. You may wish to print this topic out first, and close Help, to give yourself enough room on the screen. If you want to print this page first, just click on the "Print" button at the top.

1) Click on the **Length** tab to get to the Length/Size/Distance category.
2) Enter **21.75** in the **Inches** box and hit **<Enter>**. The **Meters** box should now read **0.55245**

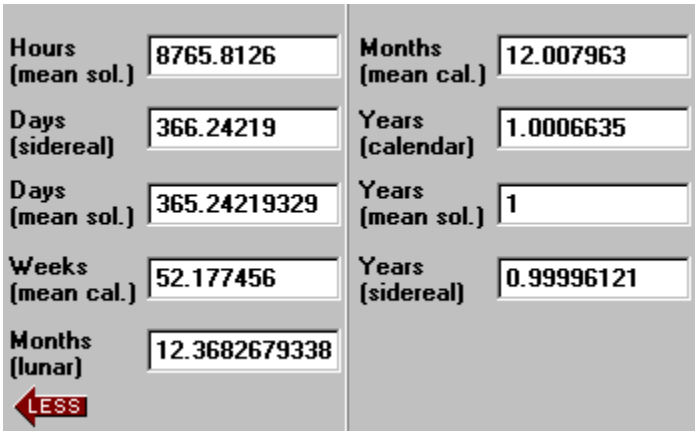
You have converted 21.75 Inches to its equivalent number of meters. Let us suppose you need to scale this number up by a factor of 17. Here is how you would proceed:

3) Click in the **Meters** box and select the number **0.55245** by dragging the mouse cursor across it to highlight it.
4) Choose **Edit|Copy** from the menus or press **Ctrl-C**. The number will be copied to the Windows clipboard.
5) Click on the **Calc** button to open Calculator if it isn't already open.
6) Check calculator's title bar to make sure Calculator is the active window and be sure it is cleared.
7) Press **Ctrl-V** or choose **Edit|Paste** from Calculator's menu; **0.55245** should appear in calculator's window.
8) Multiply the number by 17 in the usual manner. If you aren't sure how, see Calculator's Help.
9) You can copy the answer (**9.39165**) back to WAM+, if you wish, by simply reversing the process.

A "Time" Tutorial

This is a short tutorial demonstrating how to break down decimal days into hours:minutes:seconds format. The same technique is also useful for converting degrees-decimal into degrees:minutes:seconds format. (See Angular Measure.) You'll want to write down a few numbers so a pen and paper would be useful. If you want to print this page first, pull down the "File" menu and select "Print Topic".

1) Open WAM+ and click on the **Time** tab.
2) We will want to input 1 mean solar year so click on the MORE arrow to advance the "page".
3) Click on the 1 Button.
4) Click in the "Years (mean sol.) box. The dialog box should now look like this:



We can see that 1 solar year equals 365.24219329 mean solar days. But what does that mean? How many hours and minutes is .24219329 days?

5) To find out, first write down "365 days" then click in the "Days (mean sol.)" box. Delete the 365, leaving the .24219329 and hit <Enter>. Be careful not to erase the decimal point.
6) We see that this equals 5.81263896 mean solar hours. Write down "5 hours".
7) To break this down further, click in the "Hours (mean sol.)" box. Delete the 5, leaving the .81263896.
8) Click on the LESS arrow to simultaneously go back a page and recalculate.
9) We see that this equals 48.7583376 mean solar minutes. Write down "48 minutes".
10) Lastly, click in the "Minutes (mean sol.)" box. Delete the 48, leaving the .7583376 and hit <Enter>.
11) We now have 45.5002 (or about 45-1/2) mean solar seconds. Write it down.

You should have written "365 days, 5 hours, 48 minutes, 45.5 seconds".
With this technique you can break down any time period you wish, such as sidereal years, lunar months, etc.

Pi (π)

The ratio of the circumference of a circle to its diameter; approximately 3.14159265358979323846.

Reciprocal

The reciprocal of a number is that number **divided into 1**, i.e. the reciprocal of **n** is **1/n**.
Examples:

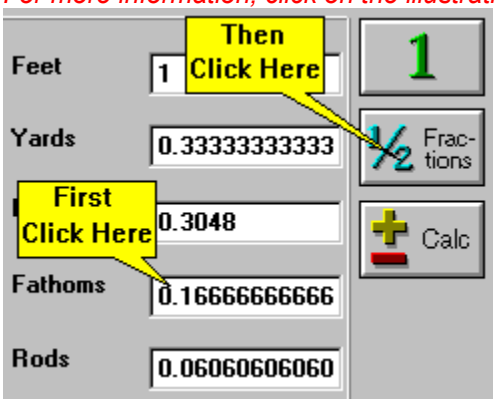
The reciprocal of 2 is 1/2.
The reciprocal of 10 is 1/10.
The reciprocal of 2/3 is 3/2 (1 ÷ 2/3) or 1-1/2.
The reciprocal of -4 is -1/4.

Any number times its reciprocal equals 1.
Dividing a number by a divisor is equivalent to multiplying it by the reciprocal of the divisor. e.g. 35 divided by 5 is the same as 35 times 1/5.

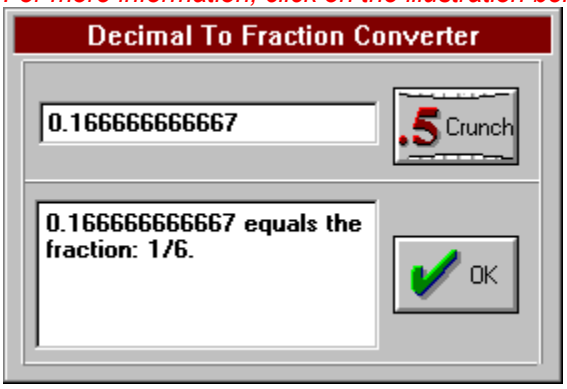
Fraction Converter

Decimals have their place, but it is often easier to relate to a fraction. The fraction 7/12 provides a much better perspective than the decimal 0.5833333333. "0.0625 cups" (one tablespoon) doesn't tell us as much as "1/16 of a cup". It is not possible to convert every decimal to a meaningful fraction but this utility will help in many cases.

To convert a decimal to a fraction or mixed number, click in any box, then click on the "Fractions" button.
For more information, click on the illustration below wherever the cursor appears



The fraction converter will open if it is closed and, if it can, it will display the fractional equivalent of the decimal you clicked on. The converter needn't be closed first. Every time you click on a new decimal then click on the fractions button a new fraction (or mixed number) will be calculated.
For more information, click on the illustration below wherever the cursor appears



To convert a fraction to a decimal, simply type in the fraction or mixed number directly in the main dialog. It will be converted automatically. See Entering Data.

Decimals Box

This is an input/output box for decimals. It displays the decimal transferred from the main dialog. You may also enter a decimal number **directly** into this box and calculate its fractional equivalent by pressing the "Crunch" button.

Entering Data

This page is concerned with entering data into the cells of the unit conversion dialog. For information on entering data in the **Trigonometry** module go to Trigonometry.

You may enter data in the unit conversion dialog in any of several formats:

Format	Example
Whole numbers	34 741776
Decimals	0.0833333333 3.1415926
Fractions	3/4 47/13
Mixed numbers (You **must** put a space or a hyphen between the integer and the fraction)	1 1/8 27-7/16 2-5/64
Scientific notation ('+' signs or leading zeros are optional; the 'e' may be upper or lower case.)	1.482056e8 4.6009E+09 2.348e-12

Once you have entered the number, press <Enter>, <Tab>, or click in any other box. WAM+ will re-calculate and update all boxes.

If you click on the 1 Button, then click in any box, a '1' will be entered in that box and WAM+ will re-calculate.

Negative numbers are allowed in the Angular Measure category only.

TIP:

If you hit the <Tab> or <Enter> key a few times you will see that the "highlight" moves in sequence from box to box. If you wish to enter a number into a box, the easiest way is to click in a box that **precedes** it in the sequence and then hit <Tab> or <Enter>. You can then enter your data without having to backspace over, or delete, the old data since Windows will do that for you.
For example, to enter a number in the fourth box from the top, click in the **third** box, press <Tab> and enter your number. Box four will clear automatically when you type the first digit.

"Crunch" Button

Pressing this button will "crunch" the number in the Decimals box and attempt to convert it into a fraction. The result appears in the information window.

Information Window

Displays various calculation results and status messages.

Crunch

A computer slang term meaning to operate on a number, or numbers, in some way as in to multiply, divide, take a square root etc.
In the Fraction Converter the "Crunch" button "crunches" the number in the Decimals box into a fraction.

Fraction Entry

You may enter any two numbers separated by a forward slash (/) character and WAM+ will interpret this as a fraction. You may enter either proper or improper fractions, or mixed numbers.

Fraction Converter Messages

The Information Window of the Decimal-To-Fraction Converter presents the user with various messages.

If the conversion was successful it will display a message of the form: "n.nnnnnn equals the fraction a/b" or "n.nnnnnn equals the mixed number c-a/b" where n stands for any digit.

If you pass it a whole number or a number in scientific notation you will get specific messages indicating those conditions.

Sometimes, however, you will get a message which reads "Sorry. WAM couldn't reduce this decimal further". At other times you may not get this message but, instead, get a huge, virtually meaningless, fraction like 16621971/35840000.
There are various reasons for this:

- The decimal may be the result of a conversion from one system to another such as fluid ounces to liters, or feet to nautical miles. In cases like these there is really no established whole-number ratio between systems and reduction to a small, neat, fraction is simply not possible. This is the most common reason.
- The decimal may have been an irrational number and not reducible to a fraction.
- The result of calculations when dealing with decimals (which are known as "floating point numbers") on a computer are subject to round-off errors. What that means is the result of a simple operation like 2.0 times 3.0 isn't necessarily 6.0. Under some conditions it comes out as 5.9999999999 or 6.000000001. WAM+ employs various techniques and methods to prevent this from occurring but when errors like this *do* creep in the results are unpredictable.

Denominator

The number after or below the bar in a fraction is called the *denominator*. It is the number by which the numerator is being divided.
In the fraction 5/8, 8 is the denominator. See also Integer, Mixed Number.

Numerator

The number before or above the bar in a fraction is called the **numerator**. It is the number being divided by the denominator.
In the fraction 5/8, 5 is the numerator. See also Integer, Mixed Number.

OK Button

Closes the fraction converter.

Systems of Measurement

The Metric System

The metric system was first proposed in France, in 1670, by Gabriel Mouton, the Vicar of Lyons. It was not adopted in France until 125 years later in April 1795. It has since become the dominant system of measurement in the world today and in scientific work it is used almost exclusively. The fundamental units of the metric system are the meter and the kilogram.

In answer to a growing need for a universal system of measurement, the Eleventh General Conference on Weights and Measures, held in Paris in 1960, defined a new set of standards based on the meter-kilogram-second (mks) system. *Le **S**ystème **I**nternational d'Unités* (The International System of Units) or SI, for short, was the name adopted.
At this conference, standards were defined for six base units: the meter, kilogram, second, ampere, kelvin, and candela, and for two supplementary units: the radian and the steradian. A seventh base unit, the mole, was added in 1971.
The SI units for all other quantities are derived from the seven base units and the two supplementary units. A series of prefixes is used to represent multiples of these units by powers of 10.
Because of the needs of the scientific community for smaller units the **centimeter-gram-second** (cgs) standard was also developed.
The U.S./British equivalent of the mks system is the foot-pound-second (fps) system.
In 1975 the United States passed the Metric Conversion Act which committed the U.S. to the increased use of, and conversion to, the metric system.

The U.S. and Imperial Systems

The fundamental units of the U.S. Customary system and the British Imperial System are the yard and the avoirdupois pound. There are no primary *standards,* however, in the U.S. system. All fundamental units are now derived from standards of the metric system such as the meter and the kilogram. This is now also true of the British Imperial System but as late as 1959, the yard and the pound were still defined by reference to primary standards created specifically for that purpose. The imperial standard yard, for instance, was defined by two lines on a bronze bar. In 1959, in an agreement between the United States and the British Commonwealth, the International Yard and the International Pound were defined in terms of the metric standard.

The U.S. and British systems differ in some areas. In the British System, the units of dry measure are the same as those for liquid measure while in the U.S. they are different. The British Imperial gallon is defined as 10 pounds of water at a temperature of 62ºF or 277.4193 cubic inches. This is equal to 1.200949 (about 1-1/5) U.S gallons. Conversely, the U.S. gallon is 0.8326747 (about 5/6) Imperial gallons or 231 cubic inches.

1 Button

The amount entered most is **1**. How many ounces is **1** gallon? How many square inches in **1** square yard? etc. Just click on this button, then click in any box. The amount in the box will change to "1" and WAM+ will re-calculate.

For information on using the main WAM calculator see the Unit Conversion Calculators topic.

Click **first** on the decimal you wish to have converted into a fraction.

No Information Available.

We could not find any real-world examples for this prefix. If you know of one, please contact the author.

If you don't put a space or dash between the whole number part and the fractional part of the mixed number, WAM+ has no way of separating them. Thus if you enter "11/12" the program assumes you mean "eleven twelfths" when you may have meant "one and one twelfth".

This is a mixed number being entered. See Entering Data.

Whole Number

A whole number or integer has no fractional or decimal component.

"Calc.exe" (Calculator) is a program that came with Microsoft Windows. It is installed in your WINDOWS directory when Windows is installed, and WAM+ looks for it there. If it has been deleted or moved, you will get an error message when you press the calc button.

Improper Fraction

If the numerator is greater than the denominator the result is called an *improper fraction* and is a fractional representation of a mixed number, e.g. the improper fraction 3/2 = 1-1/2 or 1.5.

Exponent

A small superscript number indicating what "power" or how many times a number is to be multiplied *by itself*.

Thus 5^2 (pronounced "five squared") equals 5x5 or 25, 10^3 (pronounced "ten cubed") equals 10x10x10 or 1000, and (pronounced "two to the eighth power") equals 2x2x2x2x2x2x2x2 or 256.

You're welcome.

Kilogram (kg.)

The kilogram (1,000 grams) is the fundamental SI standard of mass.

The kilogram was originally defined as the mass of 1 cubic decimeter of pure water at 4.0º C, the temperature of its maximum density.
The international prototype kilogram is now defined as a platinum-iridium cylinder of similar mass. It is maintained at constant temperature at Sèvres near Paris.
A copy of this standard is maintained in the U.S. at the National Bureau of Standards.

Weight / Mass

Although the terms "weight" and "mass" are often used interchangeably they are, strictly speaking, two different things.
Mass is the **amount** of matter that a body contains determined by its resistance to acceleration or *inertia*. The **mass** of a body **is constant** anywhere in the universe.
Weight is a measure of the **gravitational attraction** on an object by a body such as the earth or Mars. It is the product of the mass of the object times the local gravitational acceleration.
Weight varies with distance from a body and/or gravitational force of a body. An object weighing 100 pounds on the earth would weigh approximately 16 pounds in the weaker gravitational force of the moon, and be weightless in space. Its mass, however, would remain constant at 45.36 kilograms.

The kilogram is a unit of mass while **the pound is a unit of weight**.

All bodies of the **same mass** at the **same gravitational location** will **weigh the same**. What this means, for example, is that all objects with a mass of one kilogram at sea-level anywhere on the earth will weigh exactly 2.2046226 pounds. If one of these objects were on top of Mt. Everest, however, it would weigh less.

The standard mass-weight conversion factors are for earth at sea-level and these are what WAM+ uses for its calculations.

The units in the Weight / Mass category are:

Milligrams	Drams (avoir.)	Pounds (avoir.)
Grains	Drams (ap., troy)	Kilograms
Grams	Ounces (avoir.)	Tons (short)
Scruples (apoth.)	Ounces (ap., troy)	Tons (metric)
Pennyweights	Pounds (ap., troy)	Tons (long)

See also:

The Unit Conversion Calculators

Metric Prefixes

Volume

Volume is the size or extent of a three-dimensional object or region of space or the capacity of such a region.

The units in the Volume category are:

Milliliters, C.c.'s	Ounces (U.S. fluid)	Quarts (liquid)	Gallons (Brit., liq.)	Barrels (31.5 gal.)
Drams	Gills	Liters	Pecks	Barrels (petroleum)
Teaspoons	Cups (measuring)	Quarts (dry)	Cubic Feet	Hogsheads
Tablespoons	Pints (liquid)	Gallons (U.S., liq.)	Bushels	Cubic Yards
Cubic Inches	Pints (dry)	Gallons (U.S. dry)	Barrels (U.S. dry)	Cubic Meters

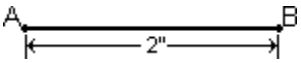
See also:

The Unit Conversion Calculators

Length / Distance

Length is the linear extent of an object along its greatest dimension.
Distance is the amount of space between two separate points.

From the definitions above we see that **length** is a property of an **object** while **distance**, a slightly more abstract concept, refers to the amount of **space** between two points (which may or may not be part of an object).



We could say that the line drawn between points A & B above has a length of 2 inches or we could say that the distance between points A & B is 2 inches. They both come out to be two inches but in the first case we are talking about a property of an object (length) while in the second case we are talking about an amount of space between two things (distance). If we were to erase the line there would still be distance between those two points in space but no length since there is no line to measure.

The units in the Length / Distance category are:

Points (printers)	Feet	Furlongs
Millimeters	Yards	Kilometers
Picas	Meters	Miles (statute)
Centimeters	Fathoms	Miles (nautical)
Inches	Rods	Light years

See also:

The Unit Conversion Calculators

Metric Prefixes

Velocity / Speed

Velocity is the rate of linear motion of a body in space in a particular direction.
The magnitude of this velocity is known as **speed** and is expressed in terms of distance covered divided by time, such as centimeters per second or miles per hour.
The units in the Volume category are:

Centimeters / hour	Inches / second	Meters / minute	Miles / hour
Centimeters / min.	Feet / hour	Meters / second	Miles / minute
Centimeters / sec.	Feet / minute	Kilometers / hour	Miles / second
Inches / hour	Feet / second	Kilometers / min.	Knots
Inches / minute	Meters / hour	Kilometers / sec.	

See also:

The Unit Conversion Calculators

Metric Prefixes

Time

Time is continuum in which actions or events occur in apparent succession from the past through the present to the future. Time is often considered to be a dimension.

Solar time is measured by the apparent motion of the sun across the sky. When the sun reaches the meridian at any given point on the earth it is noon. A solar day is the interval between two successive meridian passes of the sun. See also *mean* solar day.

Sidereal (sid dear ee al) time is time based upon the axial and orbital rotation of the earth with reference to the background of *stars*. A sidereal day is defined as the interval between two successive passes of the vernal equinox over the meridian. A full discussion of this topic is beyond the scope of this utility. For more information consult a text on basic astronomy.

Ephemeris time is a highly accurate astronomical system for the measurement of time based on the period of the earth's orbit. It is used chiefly by astronomers. WAM+ does not address ephemeris time.

The units in the Time category are:

Seconds (sidereal)	Hours (mean solar)	Months (mean calen.)
Seconds (mean sol.)	Days (sidereal)	Years (calendar)
Minutes (sidereal)	Days (mean solar)	Years (mean solar)
Minutes (mean solar)	Weeks (mean calen.)	Years (sidereal)
Hours (sidereal)	Month (lunar)	

See also:

Leap Years

A Time Tutorial

The Unit Conversion Calculators

Area

Area measure is the measure of two-dimensional plane surfaces, or the the size of an enclosed region. It is most often (but not always) given in terms of the square of a designated unit of length e.g. square meters.

The units in the Area category are:

Square Millimeters	Square Meters
Square Centimeters	Acres
Square Inches	Hectares
Square Feet	Square Kilometers
Square Yards	Square Miles

See also:

The Unit Conversion Calculators

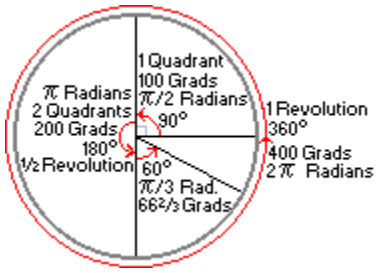
Metric Prefixes

Angular Measure

An angle is:

The figure formed by two lines, or planes, diverging from a common point such as the center of a circle.

The rotation required to bring one such line, or plane, into coincidence with the other.



The diagram above shows a circle divided into sections forming a 60º acute angle, a 90º right angle, and a 180º straight angle. The circle itself, of course, is 360º or 1 revolution. A fourth type of angle, the obtuse angle, is not shown.
From this diagram we can get an idea of the correlation between the systems of measurement.

The units in the Angle Measurement category are:

Seconds	Quadrants
Minutes	Revolutions (circles)
Grads	Sine
Degrees	Cosine
Radians	Tangent

Note: You may not enter amounts into the sine or cosine boxes greater than 1 or less than -1. If you do so, you will get an error message. Tangents may be any amount up to and including infinity, which is the tangent of 90º. The tangent box will indicate infinity by displaying "**+INF**".

Tip: To break down a degree-decimal number into degree-minute-second format, you can use the method explained in "A Time Tutorial".
For example, to break down 57.2957795131 degrees (1 radian) click in the degree box and delete the 57 leaving 0.2957795131. This gives you 17.746770786 minutes. Now delete the 17 leaving 0.746770786. This gives you 44.80624716 seconds. So 57.2957795131 degrees equals 57º17'44.8".
For more detailed instructions on this technique, see A Time Tutorial.

See also: The Unit Conversion Calculators

You are probably using the "large fonts" driver for your video display card rather than the normal or "small fonts" driver. The Windows help system's help file viewer (winhelp.exe) stretches the graphics to compensate and they distort. The program itself, WAM+, gets around this problem by various methods: In some cases there are two different sets of graphics, while the temperature module actually redraws the thermometers differently depending on the driver.

Degree (º)

A unit of angular measure equal to one 360th part of a circle. Its symbol is a small, high, circle (º). The degree is often divided into 60 smaller units called minutes or minutes of arc which are in turn divided into 60 smaller units known as seconds of arc.

The degree is, of course, also a unit of temperature measurement.

Minute Of Arc (')

A minute or minute of arc is a unit angular measure equal to 60 seconds of arc or 1/60 of a degree. Its symbol is the apostrophe.

Second Of Arc (")

A second or second of arc is a unit angular measure equal to 1/60 minute of arc or 1/3600 of a degree. Its symbol is the quotation mark.

Milligram (mg.)

A unit of mass equal to one thousandth of a gram.

H_2O
The chemical forumula for water.

Millimeter (mm.)

The meter is a basic unit of length in the metric system. A **millimeter** is **one thousandth** of a meter.
The square millimeter (mm^2) is a common unit of area.
The cubic millimeter (mm^3) is a common unit of volume.

Meridian

The highest point in the sky for any given locality. The point directly overhead. The sun's position at noon.

Before noon the sun is **A**nte **M**eridian. After noon it is **P**ost **M**eridian.

Dynamic Triangle

The triangle functions as both an input device and as a model of the triangle generated by the values in the boxes. It is designed to give a visual indication of the relationships between the sides and angles of a right triangle. It is also useful for quick approximations and as as learning tool.

To adjust the triangle simply click and drag one of the blue handles. Stretch the side until the respective "Side" box indicates the desired length.

The range of the triangle, when the scale is set at "1", is from 0 to 120 units. You may change this with the scale buttons.

This method of input is limited two significant digits. You can not, for instance, input "782.0" or "159.3". However, you can get a quick approximation by dragging to "780.0" or "160.0" with the scale set to "10". For more precise values you can enter data directly into the boxes.

30 - 45 days is reasonable.

Acute Angle

An angle less than 90 degrees. See also Angular Measure.

Obtuse Angle

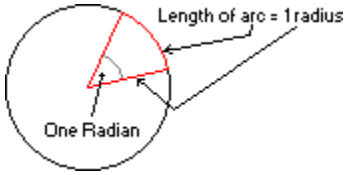
An angle greater than 90º and less than 180º. See also Angular Measure.

Straight Angle

An angle of exactly 180 degrees. See also Angular Measure.

Radian (rad.)

A unit of angular measure equal to the angle subtended at the center of a circle by an arc of length equal to the radius of the circle. The radian is a supplementary unit of the SI system.



One radian equals $360/2\pi$ degrees or 57°17'44.8".

There are 2π (6.28318530718) radians in a full circle.

See also Angular Measure

Grad (g.)

A grad (or grade) is a metric unit of measurement. A grad is 1/400 of a circle. There are 100 grads in a right angle, therefore one grad is equal to .9 degrees.

See also Angular Measure.

Quadrant (q., quad., +)

A circular arc subtending an angle of 90º. One quarter of the circumference of a circle.
See also, Angular Measure.

Revolution (r., rev.)

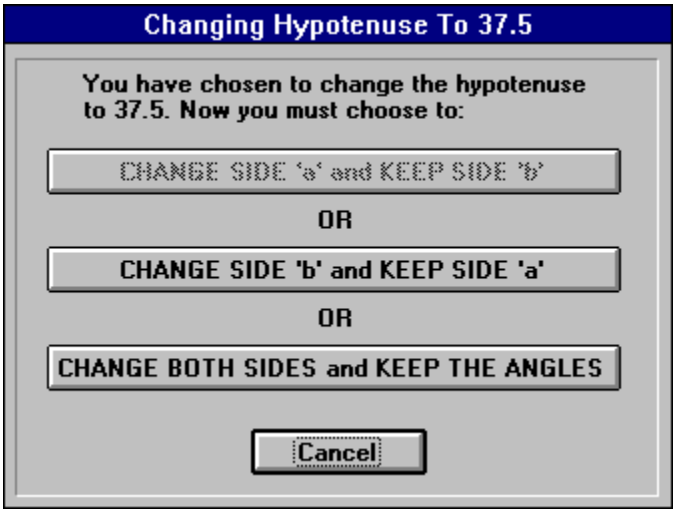
A revolution is one full circle. 360 degrees. 2π radians, 4 quadrants, or 400 grads.
See also Angular Measure.

Side Input / Output

The length of the sides are displayed in these boxes. You may manually enter any decimal amount you wish. Press <Tab>, or <Enter>, or click in another box and all values will be recalculated.

Entering A Hypotenuse

To enter a hypotenuse directly, enter an amount and press <Tab>, or <Enter>, or click in another box. This dialog will open:



When the hypotenuse is changed, the geometry of the triangle must also change. The dialog is necessary because WAM+ needs to know whether you want to change side 'a', change side 'b', or change both sides and keep the existing angles.

If the hypotenuse that is entered is less than one of the sides, one of the buttons will be grayed out as shown above. In this case we have entered a hypotenuse of 37.5 for a triangle where side 'a' is 30 and side 'b' is 40. We do not have the option of keeping side 'b' because it is greater than the hypotenuse and the hypotenuse **must** be greater than either side.

Had the hypotenuse been less than both sides, only the bottom button would have been enabled.

Hypotenuse Input / Output

The hypotenuse is displayed in this box. You may enter the hypotenuse directly. For instructions on how to do so see Entering A Hypotenuse.

Entering Angles

WAM+ provides great flexibility in the way angles are entered. You may enter whole degrees, degrees-decimal, degrees:minutes, whole minutes, minutes-decimal, or degrees:minutes-decimal.
This version of WAM+ does not directly support seconds of arc. Seconds are represented by the decimal component of the minutes value. Thus 72º 12.75' would be the equivalent of 72º 12' 45".

To enter **whole degrees** or degrees-decimal all you need to do is type the number.
Examples: 24 76 13.5 34.788424
Degree values **must** be 90º or less. The **decimal** component in a degrees-decimal entry **may** exceed 90. e.g. 23.92º is legal but 92.23º is not.
Please note that the decimal point indicates a **decimal** amount. That is, 28.50º is **not** 28º 50' it is equivalent to 28-1/2 degrees or 28º 30'. To enter 28º 50' directly see below.

To enter a **minutes** value with no degrees (0º) just enter the number followed by an apostrophe (') - the symbol for minutes. The program will know you mean minutes rather than degrees and enter 0º for you.
Examples: 10' 56.62' 37.32098'
Minutes values **must** be 60' or less. As mentioned above, the decimal component may be any amount. Thus 56.67' is legal while 67.56' is not.

To enter a **degrees:minutes** or **degrees:minutes-decimal** value you must **separate** the degree value from the minutes value with a "**d**", or "**D**" (for **d**egrees), a **space**, or a degree symbol(º). Any other symbols will produce an error message.
Examples:
49d38 49 38' 49D38.00 49º38 27d52.782349 56d08 56d8
The first four examples are all equivalent. i.e. 49 degrees-38 minutes. The last two values are also equivalent. Even though there is no zero in front of the eight in the last example, WAM+ is smart enough to know that we mean to enter "8" not "80" and will read it correctly. The "filler" zero in the sixth example is unnecessary. Long decimals such as in the fifth example are processed internally by WAM+ and their accuracy is preserved, but they will not be displayed as long decimals after calculation.

Once the angle is entered, press <Tab>, or <Enter> and a dialog similar to the one described in Entering a Hypotenuse will open.
Whenever an angle is changed, the geometry of the triangle must also change. Two sides and the other acute angle must change but one side will not change. WAM+ needs to know which of the three sides you wish to keep. As an aid, the "Side" boxes are labeled "Opposite" or "Adjacent".

Note:
The acute angles in a triangle are customarily designated by Greek letters such as α or β. This would have been impractical for various reasons so angles in WAM+ are designated by their vertices.

Poof! You're there!

Trigonometric Function Readouts

These are the sine, cosine, and tangents of the angles directly above them. They update automatically whenever there is any change.

Scale Buttons

Each time the button is pressed the scale factor is multiplied by ten . Each time the button is pressed the scale factor is divided by ten.
The amounts in the "Side a", "Side b", and "Hypotenuse" boxes will be multiplied by the new scale factor.
The current scale factor is indicated just above the buttons.
Notice that scale factor has no effect on the angles. Multiplying all sides of a triangle by the same amount causes all angles to stay the same.

Volume

Volume is the size or extent of a three-dimensional object or region of space or the capacity of such a region.

See the main topic Volume.

Velocity

Velocity is the rate of linear motion of a body in space in a particular direction.
See also Speed, Velocity / Speed

Weight (wgt.)

Weight is a measure of the **gravitational attraction** on an object by a body such as the earth or Mars. It is the product of the mass of the object times the local gravitational acceleration.
For full information see Weight / Mass.

Mass (M.)

Mass is the **amount** of matter that a body contains determined by its resistance to acceleration or *inertia*.
The **mass** of a body **is constant** anywhere in the universe.
See also Weight, and Weight / Mass.

Speed

Speed is the magnitude of a velocity and is expressed in terms of distance covered divided by time, such as centimeters per second or miles per hour.
For full information see Velocity / Speed.

Distance

Distance is the amount of *space* between two separate points.
See also Length, and Length / Distance.

Length

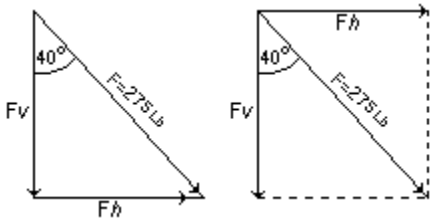
Length is the linear extent of an *object* along its greatest dimension.
See also Distance, and Length / Distance.

Solved Problems 1

A support wire is to be attached to a flagpole 100 feet from the ground at a 50º angle. How much wire do you need to buy?

Answer: We need to solve for the hypotenuse (Side "c"). Enter 100 for side "a". (The easiest way is to just drag side "a" on the triangle to 100). Enter 50 for angle A. Notice that when you clicked in the angle box the "Side" boxes labeled themselves "opposite" and "adjacent". Choose "Keep The Opposite Side" which is side "a". The hypotenuse reads 130.541. You'd better buy 140' so you can attach it.

If the wire you just installed in the preceding problem exerts a pull of F=275 lb. what are the horizontal and vertical components F*h* and F*v* of the pulling force F?



Answer: The diagram on the left indicates the triangle formed by the pole, the wire, and the ground. On the right is the vector diagram. The problem is a little clearer if we use the 40º angle at the top. (See A Brief Review if you don't know why this is a 40º angle).
The force exerted vertically down toward the ground is labeled F*v* and the horizontal force is F*h*. The solution is like any other triangle. First enter the 40º angle into the "Angle B" box. Choose any button when the dialog pops up. Now enter 275 for the hypotenuse and choose "Change Both Sides and Keep The Angles". You're done! F*v* = Side "a" = 210.66. F*h* = Side "b" = 176.77.

Click here to go to Solved Problems 2 or click on the **>>** button at the top.

Click here to go back to the Trigonometry topic.

Angle Input / Output

The angles are displayed in these boxes.
The acute angles in a triangle are customarily designated by Greek letters such as α or β. This would have been impractical for various reasons so angles in WAM+ are designated by their vertices.
You may enter angles directly. For instructions on how to do so see Entering Angles.
Note:

In some cases, whole degrees may be displayed as n-1 degrees and 60 minutes. For example, if the angle is 30 degrees, the display may read 29 degrees and 60 minutes as is shown in this graphic. Since 60 minutes equals one degree this is not an inaccuracy. It is a result of how the computer handles decimals and is not a bug.

Degree Symbol (º)

Degrees are indicated by a small, high, circle.
To get a degree symbol in Windows, hold down the <Alt> key and enter 0 1 7 6 on the numeric keypad.
When you **release** the <Alt> key the ° symbol will appear. This works with most fonts.

A Brief Review Part 2

We know now that the ratio of the opposite side to the adjacent side of our 36º 52.19' angle is 3/4, and the ratio of the adjacent side to the hypotenuse is 4/5. So **if we know one angle and only one of the sides it is a simple matter to find the others.** For example, if the adjacent side to this angle is 64, then by simple arithmetic we can determine that the opposite side must be 48, and the hypotenuse must be 80. These ratios are so central to trigonometry that they have been given names. If A is an acute angle in a right triangle then:

The three ratios (called "trigonometric functions") on the right, the cosecant, secant, and cotangent, are the reciprocals of the sine, cosine, and tangent on the left and are not used as much. Most problems in trigonometry are solved by using just the sine, cosine, and tangent functions.

In our example triangle with a 36º 52.19' angle:
The **sine** is 30/50 or **.6**
The **cosine** is 40/50 or **.8**
The **tangent** is 30/40 or **.75**

Click here to go on to page 3 or click on the **>>** button at the top.

Click here to go back to page 1 or click on the **<<** button at the top.

Click here to go back to the Trigonometry topic.

A Brief Review Part 1

When two right triangles have the same acute angle, as the red and blue triangles above do, they are *similar* triangles and have other properties in common:

Their remaining acute angles are the same. This is because the sum of the angles in any triangle is **always** 180º. Since, by definition, one of the angles of a right triangle is 90º, the sum of the two remaining acute angles must also be 90º. Therefore if the triangles have one acute angle in common they have both in common. In the example above, the triangles both have an angle of 36º 52.19'. and therefore the remaining angle has to be 53º 07.81'. (See Subtracting Angles)

Their sides are proportional. What this means is that, for any angle, the **ratio** of the opposite side to the adjacent side is the same in both triangles. In our example above, the ratio of sides a/b in the blue triangle is the same as the ratio of sides a'/b' in the red. i.e. 30/40 = 60/80. In fact, the same is true for **all** sides and angles. It can be proven mathematically that **all** similar right triangles will have their sides in the same proportions.

What we are saying, then, is that **if the angles remain the same**, it does not matter what size the triangle is **the proportions will remain the same**. If that is true, then the proportions of **any** right triangle with a 36º 52.19' angle in it should be in the proportions 3:4:5.

You can easily see this for yourself. Bring up the Trigonometry module in WAM+. The default triangle is the same as the blue one above. Now click in the hypotenuse box and change the number. When the dialog box pops up choose "CHANGE BOTH SIDES and KEEP THE ANGLES". No matter what you entered for a hypotenuse the sides will remain in a 3:4:5 ratio because the angles did not change.

If the ratios of the sides for a given angle in a right triangle are always the same, then we can use that fact to solve for unknowns! As long as you know at least **one angle and a side**, or **two sides** you can solve any right triangle. That is what trigonometry is all about.

Click here to go on to page 2 or click on the **>>** button at the top.

Click here to go back to the Trigonometry topic.

But not here. Go and buy a math book.

A Brief Review Part 3

In order for these ratios, or functions, to be useful we must know the sine, cosine, and tangent of any given angle. Most of the work has already been done for us in the form of **Trigonometric Tables**. These are published tables giving the sine, cosine, and tangents for angles between 0º and 90º. With tables like these we can work backwards and find an angle when given only two sides. For instance if we have the hypotenuse and an adjacent side of an unknown angle, we simply divide the adjacent side by the hypotenuse to get the cosine of the desired angle. Then we look up the cosine in the tables to find the angle. Simple huh? Well, not really. Most tables only deal with whole degrees like 24º 00'. You will never find an angle like 36º 52.19' in a common trig table. It was chosen for this tutorial because of the simplicity of its sine, cosine, and tangent. To solve for an angle like that, you have to go through an error-prone process of interpolating between two values in the tables. Fortunately for you, you have a copy of WAM+ and you need not concern yourself with tables at all. Just enter your unknowns and the program takes care of the rest.

This has been a very brief review of the elementary building blocks of trigonometry. If you want to find out more about this interesting and useful branch of mathematics we refer you to the many good books on trigonometry available at most book stores.

This ends our brief review, click here to see some solved problems or click on the **>>** button at the top.

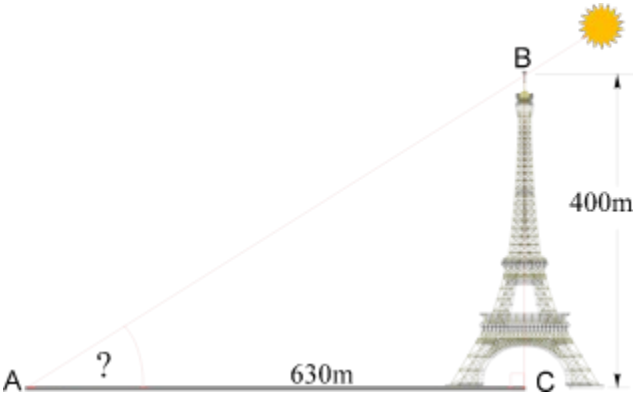
Click here to go back to page 2 or click on the **<<** button at the top.

Click here to go back to the Trigonometry topic.

You lucky person! You **are** going to buy this program aren't you?

Solved Problems 2

The Eiffel Tower, which is 400m high, casts a shadow 630m long. What is the angle of elevation of the sun?



Answer: This problem can be solved with the dynamic triangle. Change the scale to 10 with the scale buttons. Drag side "b" until the readout says "630". Drag side "a" until it reads "400". The sun's angle, 32°24.74', should be in the "Angle A" box.

You are on an expedition to climb Mt. Everest. As you approach the mountain you set up your trusty portable transit (**!**) and determine the angle of elevation of the mountain's peak to be 16º15'. Everest is 8848 meters high. How much farther must you shlep to get to the base of the mountain?

Answer: You turn to your trusty sherpa who hands you your trusty laptop with a trusty copy of WAM+ on it. You enter 8848 for side "a". You enter "16D15" in the "Angle A" box and choose "Keep The Opposite Side" from the dialog. You read 30356.11 meters from the "Side b" box. Only about 30 kilometers to go. Good luck!

Click here to go to page 1 or click on the **<<** button at the top.

Click here to go back to the Trigonometry topic.

A pound of feathers.

If you said "You can't fool me. A pound is a pound." you *have* been fooled.
Feathers are measured by the avoirdupois system while gold is measured by troy weight. An avoirdupois pound weighs 7000 grains while a troy pound only weighs 5760 grains.

Accuracy

Every attempt has been made to make WAM+ as accurate as possible. We believe it is **the** most accurate unit-conversion software available today. All calculation is done using "long", "double-precision" variables. Additionally, special algorithms have been employed to minimize round-off errors. If anyone finds any ***significant*** inaccuracies, e.g. a misplaced decimal etc., we would appreciate it if he or she would contact the author. The first person reporting each such error will receive a free copy of this software and our undying gratitude. Please do not bother reporting small round-off errors in the umpteenth decimal place. Talk to Intel instead.

This being the era of litigation we must add some fine print:

> Users of WAM+ must accept this disclaimer of warranty: WAM+ is supplied as is. The author disclaims all warranties, expressed or implied, including, without limitation, the warranties of merchantability and of fitness for any purpose. The author assumes no liability for damages, direct or consequential, which may result from the use of WAM+.

For those of you who can't get enough of this stuff see Copyright/Distribution/Legal information and Shareware Information.

File List

The following is a list of files that should have been included with this program. *If any of these files is missing you do not have a complete copy of this program* and you should either download this software from a different bulletin board or obtain a copy from Equinox.
In addition to this file list there is also a separate file list (FILELIST.DOC) in ASCII text format included. It will contain up-to-the-minute file dates and file sizes. The reason for a separate file list in this help file is that it is more difficult to alter a help file. This offers a measure of protection against altered or incomplete copies of the software. BOTH FILE LISTS MUST AGREE.

Files ending in an underscore are compressed and will be decompressed by the installation program.

The following files are copied to your WAM+ directory.

WAM.EX _	Main executable
WAM.HL_	Main Help File (this file)
WAMREG.HL_	Shareware/Registration info
SAXTABS.VB_	Notebook tabs control
FILELIST.DOC	ASCII-format file list
READ1ST.WR_	Initial information
WHATSNEW.WR_	Version information
FILE_ID.DIZ	Description of the program

The following files are copied to your WINDOWS/SYSTEM directory.
They may have already been there and in use by other programs in your system so be careful about deleting them if you wish to uninstall WAM+.

BWCC.DL_	Needed for "Borland look"
BIVBX102.DL_	VBX Emulation library for Borland C++
CTL3DV2.DL_	For the "3D" look

The following files (Small Fonts) are almost certainly already in your WINDOWS/SYSTEM directory as they were installed along with Windows. But, just in case they were erased, they will be reinstalled because WAM+ needs them.

SMALLE.FO_	Small size fonts (VGA)
SMALLF.FO_	Small size fonts (8514)

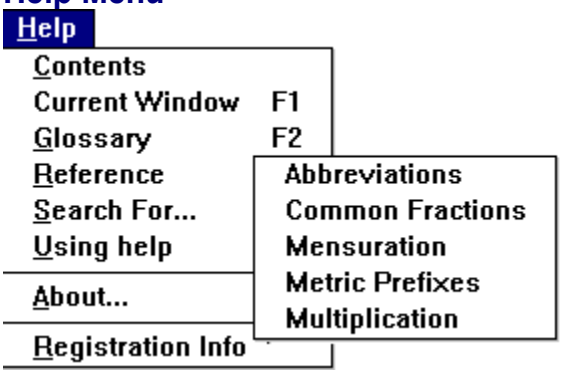
The following files are used during installation only and may be deleted from your temporary installation directory after installation.
They will NOT be copied to your final application directory.
They must be included, though, if you redistribute this software.

INSTALDR.EX_	Installation stuff
SETUP.EXE	Installation stuff
INSTALL.INF	Installation stuff
WAM.ICO	WAM's icon
EQUICAST.BM_	Equinox logo
CTL3D.DL_	For "3D" look while installing

If you wish to pass this program along to a friend, ALL of these files MUST be included. We would much prefer that the original compressed file, (WAM20.ZIP), from which all of these files came, be passed along instead. Besides, it is easier to pass along one file than a whole collection.

See also Copyright/Distribution Information

Help Menu



Highlighting **Contents** brings you to the first or, contents, page in this help file. Choosing **Current Window**, or pressing the <**F1**> key, opens up the help topic associated with the current window unless the Fraction Converter window is open. If so, you will get help for that. **Glossary** or <**F2**> brings up the glossary. **Reference** opens a sub-menu consisting of five useful reference tables. **Search For...** opens the usual keyword search dialog box where you may search for topics. **Using Help** invokes Windows' "How to Use Help" for users unfamiliar with the help system. **About...** brings up a small "About" dialog box. If you have not registered the program there will be a **Registration Info** command which will open the Shareware/Registration information help file. This menu choice will disappear after you register but you can still access it, if you wish, from the Contents page.

Groan! Booo! Hiss!

SI

Short for *Le **S**ystème **I**nternational d'Unités* or International System of Units. See Systems of Measurement.

Ampere (A.)

The ampere, named after the French physicist André Marie Ampère (1775-1836), is the basic unit of electrical current. In SI, the ampere is defined as the constant current that, flowing in two parallel conductors one meter apart in a vacuum, will produce a force between the conductors of 2 × newtons per meter of length.
Ampere unit-conversions are not addressed by WAM+ but may be included in future releases.
See also milliampere.

Candela (cd.)

The SI standard of luminous intensity. It is equal to 1/60 of the luminous intensity of a square centimeter of a blackbody radiating at the temperature of the solidification of platinum (2046.66ºK). Also called a "candle" or "standard candle".
Candela unit-conversions are not addressed by WAM+ at this time.

Steradian (sr.)

A supplementary unit in the SI system, the steradian is a unit of measure equal to the solid angle subtended at the center of a sphere by an area equal to the radius squared on the surface of the sphere. One could probably think of it as the solid or 3D version of the radian.
The total solid angle of a sphere is 4π steradians.
WAM+ doesn't do steradians.

Mole (mol.)

The mole is defined as the **amount of substance** of a system that contains as many elementary entities as there are atoms in 0.012 kilogram of carbon-12.
WAM+ doesn't do moles.

Meter-kilogram-second (mks.) system

A coherent system of units for mechanics using the meter, the kilogram, and the second as basic units of length, mass, and time. Subsequently the ampere, a unit of electromagnetic current, was added to form the **meter-kilogram-second-ampere (mksA.)** system.

Centimeter-gram-second (cgs.) system

Because of the needs of the scientific community for smaller units the **centimeter-gram-second (cgs.)** standard was also developed.

See also Foot-pound-second system, Systems of Measurement.

Dyne (dyn.)

A basic unit of force in the cgs system equal to the force required to impart an acceleration of one centimeter per second per second (1 cm/sec²) to a mass of one gram.
See also newton, poundal.

Negative Number

A number less than 0. e.g. -5, -23.4567, -1/4 etc.

Force

Force is a vector quantity indicating a strength or energy that tends to produce a change of motion or shape of a body in the direction of its application. The basic units of force are the dyne, the newton, and the poundal.
See also Energy / Work.

Vector

A quantity possessing **both** magnitude and direction.

Erg

The centimeter-gram-second unit of energy or work equal to the work done by the force of one dyne acting over a distance of one centimeter. Also known as a **dyne-centimeter**. It is equal to joules. See also Energy / Work.

Energy (e., E)

Energy is the **capacity** of matter to do work as the result of its motion or its position in relation to forces acting on it. Energy associated with **motion** is known as **kinetic** energy, and energy related to **position** is called **potential** energy.
See also Energy / Work.

Foot-Poundal (ft.-pdl.)

A foot-pound-second system unit of work or energy equal to the work done by a force of one poundal acting through a distance of one foot in the direction of the force.
See also Energy / Work.

Foot-Pound (ft.-lb.)

A unit of work or energy equal to the work done by a force of one pound acting through a distance of one foot in the direction of the force.
See also Energy / Work.

Energy / Work

Work and energy are closely related and their units are identical.
Energy is the **capacity** of matter to do work as the result of its motion or its position in relation to forces acting on it. Energy associated with **motion** is known as **kinetic** energy, and energy related to **position** is called **potential** energy.
Work is the product of the force applied to a body and the **distance** that body travels in the **direction** of the applied force.
While work is being done on a body, energy is being transferred to that body.
Work, then, can be thought of as *energy in a state of transit*.

The diagram above represents a top view of a pinball and plunger mechanism. The spring is in a relaxed state and there is no energy present.

If we pull back on the plunger we are performing work as we compress the spring. In so doing, we have transferred our energy to the spring. Until we release the plunger, the energy we have stored in the spring is potential energy. (Since the table is tilted the ball follows the plunger because of gravity)

When we release the plunger, the energy we stored in the spring changes from potential energy to kinetic energy as the spring expands. The expanding spring pushes on the plunger and work is done because there is a transfer of energy from the spring to the plunger snapping the plunger forward. Work is performed again by the plunger as its forward energy is transferred to the ball propelling it forward. Mechanical energy is illustrated here but there are many kinds of energy including electrical, chemical, thermal, atomic, and radiant.

The units in the Energy / Work category are:

Ergs | Dyne-cm.	Calories, gram	Horsepower-hours
Gram-centimeters	Kilogram-meters	Kilowatt-hours
Foot-poundals	B.t.u.'s	
Joules | Watt-secs.	Watt-hours	
Foot-pounds	Calories, kilogram	

See also:

The Unit Conversion Calculators

Metric Prefixes

Work (w., W)

Work is the product of the force applied to a body and the **distance** that body travels in the **direction** of the applied force.
While work is done on a body, energy is transferred to that body. *Work, then, can be thought of as energy in a state of transit*.
See also Energy / Work.

Foot-pound-second (fps) system

A system of units in the U.S.customary or English systems of measurement based on the foot, the pound, and the second as the fundamental units of distance, weight, and time. The U.S.customary or English equivalent of the mks system.

See also Systems of Measurement.

Poundal (pdl.)

The foot-pound-second unit of force, equal to the force that produces an acceleration of one foot per second per second on a mass of one pound.
See also dyne, newton.

Gram-centimeter (g.-cm.)

A centimeter-gram-second system unit of work or energy equal to the work done by a force of one gram acting through a distance of one centimeter in the direction of the force.
See also Energy / Work.

Newton (N.)

A basic unit of force in the mks system equal to the force required to impart an acceleration of one meter per second per second to a mass of one kilogram.
Formerly known as a large dyne.
The newton was named for the great English mathematician, scientist, and philosopher Sir Isaac Newton (1642-1727).
See also dyne, poundal.

Kilogram-meter (kg.-m.)

A meter-kilogram-second system unit of work or energy equal to the work done by a force of one kilogram acting through a distance of one meter in the direction of the force.
See also Energy / Work.

Joule (j., J.)

The joule, also known as a **newton-meter**, is an mks unit of work or energy, equal to the work done by the force of one newton when its point of application moves through a distance of one meter in the direction of the force. One joule equals ergs or one watt-second.
The joule is named for the British physicist James Prescott Joule (1818-1889).

Notice that **one joule = one watt-second** and **one watt = one joule per second**.
See also Energy / Work.

Calorie, gram (cal.)

Calories, like Btu's, are a measure of **heat** which is another form of energy transfer.
The **gram calorie**, or **small calorie**, is defined as the amount of heat required to raise the temperature of 1 gram of water from 14.5° to 15.5° C when the water is at a pressure of one atmosphere. It is equal to 4.1840 joules.

Calorie, kilogram (Cal.)

The **kilogram calorie**, **large calorie**, **kilocalorie,** or **great calorie** is defined as a quantity of heat equal to 1,000 gram calories. The heat output of organisms and the fuel or energy value of food is measured in kilogram calories.

See also Energy / Work.

Pressure (P)

Pressure is force applied over a surface with the force acting at right angles to the surface uniformly in all directions. It is usually measured as force per unit of area such as pounds per square inch.
Also see the main topic Pressure.

British thermal unit (B.t.u.)

The amount of heat required to raise the temperature of one pound of water one degree fahrenheit.
See also Energy / Work.

Watt-hour (Wh.)

The watt-hour is a unit of energy or work, chiefly electrical energy or work, equal to one watt of power acting for one hour. It is equivalent to 3,600 joules.
See also Energy / Work.

Power (P)

Power, in **physics**, is defined as work done or energy transferred per unit of time. i.e. The time rate of doing work.
Power, in **electricity**, is defined as the product of applied potential difference (or voltage) and current (or amperage) in a direct current circuit.
For more information see the main topic Power.

Watt (W)

The watt is the mks unit of power, equivalent to one joule per second.
Named after James Watt (1736-1819), the great Scottish inventor and mechanical engineer.
Also see the main topic Power.

Dyne-centimeter

See erg.

Kilowatt-hour (kWh., kwhr.)

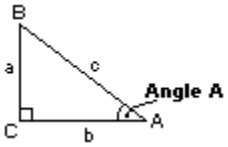
A unit of energy, chiefly electrical energy, equivalent to the the energy transferred or expended in one hour by one kilowatt of power.
See also Energy / Work.

Kilowatt (kW.)

A unit of power, usually electrical power, equal to 1000 watts.
Also see the main topic Power.

Horsepower-hour (hp.-hr.)

A foot-pound-second unit of energy or work, equal to the work done by a mechanism with a power output of one horsepower for a period of one hour.
See also Energy / Work.



Horsepower (hp.)

There are several different units of horsepower measurement. WAM+ addresses three of them:

Mechanical horsepower is a foot-pound-second unit of power indicating work done at the rate of 550 foot-pounds per second. This equals 33000 foot-pounds per minute or 745.7 watts. This is the standard or common horsepower. The horsepower was invented in 1782 by James Watt.

Electrical horsepower is very slightly larger than mechanical horsepower and is defined as exactly 746 watts.

Metric horsepower, also known as **cheval-vapeur**, is the standard horsepower of the metric system. It is defined as the power required to raise a weight of 75 kg one meter in one second or 75 kilogram-meters per second.

Two more units not addressed by WAM+ are:

Boiler horsepower is a unit of measurement of the ability of a boiler to evaporate 34.5 pounds of water an hour into dry saturated steam from and at 212° F. To convert boiler horsepower to mechanical horsepower multiply by 13.1548. To convert mechanical horsepower to boiler horsepower multiply by 0.0760181.

Water horsepower is the power required to raise 3960 gallons of water per minute a height of one foot. To convert water horsepower to mechanical horsepower multiply by 1.00046. To convert mechanical horsepower to water horsepower multiply by 0.999401.

Also see the main topic Power.

Power

Power, in **physics**, is defined as work done or energy transferred **per unit of time**. i.e. The time rate of doing work.
Power, in **electricity**, is defined as the product of applied potential difference (or voltage) and current (or amperage) in a direct current circuit.
Physical power and electrical power are interrelated and one can easily be converted to the other.

The units in the Power category are:

Ergs / sec. | Dyn-cm / sec.	B.t.u.'s / hour	Horsepower (metric)
Gram-centimeters / sec.	Watts | Joules / sec.	Horsepower (mechanical)
Foot-pounds / hour	Foot-pounds / second	Horsepower (electrical)
Foot-pounds / minute	B.t.u.'s / minute	Kilowatts
Gram calories / minute	Kilogram Calories / min.	B.t.u.'s / second

See also:

- The Unit Conversion Calculators
- Energy / Work
- Time
- Metric Prefixes

Pressure

Pressure is force applied over a surface with the force acting at right angles to the surface uniformly in all directions.
Pressure is not a fundamental quantity but, rather is derived from force and area, which in turn are derived from mass, length, and time which **are** fundamental quantities.
In the British or U.S. Customary systems, pressure is usually measured in pounds per square inch (PSI).
In international usage pressure is measured in grams or kilograms per square centimeter, or in atmospheres.
In the SI system it is measured in newtons per square meter.
Pressure is also measured in terms of columns of water (H_2O) or mercury (Hg) at specified heights and standard temperatures in a standard gravity; e.g. cm. of H_2O at 4ºC or in. of Hg at 32ºF at sea level.

The units in the Pressure category are:

Dynes / cm^2 | Microbars	Cm. of H_2O (4ºC.)	Ounces / in^2	Tons / ft^2
Newtons / m^2 | Pascals	Grams / cm^2	Cm. of Hg (0ºC.)	Kilograms / cm^2
Ounces / ft^2	Millibars	Feet of H_2O (39.2ºF.)	Bars
Kilograms / m^2	Torrs | Mm. of Hg (0ºC.)	Inches of Hg (32ºF.)	Atmospheres
Pounds / ft^2	Inches of H_2O (39.2ºF.)	Pounds / in^2	Tons / in^2

See also:

The Unit Conversion Calculators

Metric Prefixes

Volt (V.)

A volt is the mks unit of potential difference or electromotive force (emf). It is equal to the potential difference or electromotive force that will cause a current of one ampere to flow through a conductor with a resistance of one ohm.
It is named after the Italian physicist Count Alessandro Volta (1745-1827).

James Watt (1736-1819), the Scottish engineer and inventor, invented the horsepower in 1782 as a selling aid for his steam pumping engines. He estimated that the average Scottish horse exerted a pull of 180 lbs. Such a horse, when harnessed to a capstan, would walk around a circle of 24 feet diameter about two and a half times per minute. This gave a rate of work of 32400 foot-pounds per minute which he rounded off to 33000 foot-pounds per minute. The formal definition of a horsepower was published in 1809.

Area

Area measure is the measure of two-dimensional plane surfaces, or the size of an enclosed region. It is most often (but not always) given in terms of the square of a designated unit of length e.g. square millimeters.
For more information see Area.

Time (t., T.)

A continuum in which actions or events occur in apparent succession from the past through the present to the future. Time is often considered to be a dimension.
There are several ways of reckoning time; among them being Solar time, Sidereal time, and Ephemeris time.
For more information, see the main topic Time.

Subtracting Angles

In this case, we wish to subtract an angle of 36º 52.19' (read as "36 degrees 52 and 19/100 minutes" or "36 degrees 52 point 19 minutes") from an angle of 90º.

```
   90º 00.00'
  -36º 52.19'
------------------
```

To be able to do our subtraction we have to "borrow" one degree from the 90 degrees. Since one degree equals sixty minutes our problem now becomes:

```
   89º 60.00'
  -36º 52.19'
------------------
    52º 07.81'
```

And our answer is 52 degrees 7 and 81/100 minutes.

Hg

The chemical symbol for mercury.

Atmosphere (atm.)

One atmosphere is defined as a pressure of 1.03323 kg/sq cm (or 14.69595 lb/sq in).
On a mercury barometer this corresponds to 760 torrs or 760 mm (or 29.921 in) of mercury.

Torr

The torr is a unit of pressure equal to 1/760th of an atmosphere; it differs from of one millimeter of mercury (Hg) by less than one part in 7 million. It is equal to 133322 millibars.
It is named after Evangelista Torricelli (1608-1647), the Florentine scientist who discovered the properties of the barometer.

Millibar (mb.)

A unit of atmospheric pressure equal to one-thousandth of a bar.
See also bar, barye, microbar.

Bar (b.)

A unit of pressure equal to 1,000,000 dynes/cm², 0.986923 atmospheres, or 750.062 torr.
Two pressure units called bar were in use during the first half of the 20th century. One gave pressure in dyne/cm² the other in units of dyne/cm². The former was used in acoustics but was replaced by the dyne/cm² in 1951. Acoustic pressure of the order of one dyne/cm² is now described by the microbar or barye.
Also see the main topic pressure.

Microbar (μb)

A unit of atmospheric pressure equal to one millionth of a bar. It is equal to one dyne/cm² or 0.1 newton/m².
Also known as a barye.
Also see the main topic pressure.

Pascal (Pa.)

The pascal is a unit of pressure equal to the pressure resulting from the force of one newton acting uniformly over an area of one square meter.
It was named for Blaise Pascal (1623-1662) the great French mathematician and philosopher.

Large dyne

See newton.

Acceleration

The rate of change of velocity with respect to time.

Newton-meter

See joule

Barye

A unit of atmospheric pressure equal to a millionth of a bar. A microbar. Also equal to one dyne/cm² or 0.1 newton/m².

Abbreviations

Also see the Glossary

a.	acre
A.	ampere
ap., apoth	apothecaries' weight
atm.	atmosphere
avoir., avdp.	avoirdupois weight
b.	bar
bbl., bl.	barrel
B.t.u.	British thermal unit
bu., bsh.	bushel
c.	cup
C.	Celsius, Centigrade
cal.	calendar, small or gram calorie
Cal.	large or kilogram calorie
cd.	candela
cgs.	centimeter-gram-second
cm.	centimeter
cos.	cosine
cu.	cubic
db.	decibel
dr.	dram
dwt.	pennyweight
e., E.	energy
F.	Fahrenheit, force
fath., fm.	fathom
fps.	foot-pound-second
ft., '	foot
ft-lb.	foot-pound
ft-pdl.	foot-poundal
fur.	furlong
g.	gram, grad
gal.	gallon
g.-cm.	gram-centimeter
gi.	gill
gr.	grain
ha.	hectare
hhd.	hogshead
hp.	horsepower
hp.-hr.	horsepower-hour
hr.	hour
in., "	inch
j., J.	joule
K.	Kelvin
kg.	kilogram
kg.-m.	kilogram-meter
km.	kilometer
kn.	knot
kw.	kilowatt
kWh., kwhr.	kilowatt-hour
l., lit.	liter
lb.	pound
lt.-yr.	light year
m.	meter, minute
M.	mass
mA.	milliampere
mb.	millibar
mg.	milligram
Mhz.	megahertz
min., '	minute
mi.	mile
mks.	meter-kilogram-second
ml.	milliliter
mm.	millimeter
N.	newton
nm., n.m.	nautical mile
ns., nsec.	nanosecond
oz.	ounce
P.	power, pressure
Pa.	pascal
pdl.	poundal
pk.	peck
pt.	pint
pwt.	pennyweight
q., quad	quadrant
qt.	quart
rad.	radian
rd.	rod
rev.	revolution
s., sec., "	second
sc., scr.	scruple
SI.	Système International
sin	sine
sol.	solar
sq.	square
tan	tangent
tbs., tbsp.	tablespoon
tsp.	teaspoon
V.	volt
w., W	work
W.	watt
wgt.	weight
Wh.	watt-hour
wk.	week
Ws.	watt-second
yd.	yard
yr.	year

Common Fractions

This table has been provided as a convenience but, strictly speaking, it is unnecessary.
Fractions may be entered directly into any cell in WAM+ (see Entering Data) and the Fraction Converter will convert many more decimals than shown here to fractions. Some may find this table handier for looking up a fraction quickly,though .

Decimal Equivalents of 8ths, 16ths, 32nds, & 64ths

8ths	32nds	64ths	64ths
1/8=.125	1/32=.03125	1/64=.015625	33/64=.515625
1/4=.250	3/32=.09375	3/64=.046875	35/64=.546875
3/8=.375	5/32=.15625	5/64=.078125	37/64=.578125
1/2=.500	7/32=.21875	7/64=.109375	39/64=.609375
5/8=.625	9/32=.28125	9/64=.140625	41/64=.640625
3/4=.750	11/32=.34375	11/64=.171875	43/64=.671875
7/8=.875	13/32=.40625	13/64=.203125	45/64=.703125
16ths	15/32=.46875	15/64=.234375	47/64=.734375
1/16=.0625	17/32=.53125	17/64=.265625	49/64=.765625
3/16=.1875	19/32=.59375	19/64=.296875	51/64=.796875
5/16=.3125	21/32=.65625	21/64=.328125	53/64=.828125
7/16=.4375	23/32=.71875	23/64=.359375	55/64=.859375
9/16=.5625	25/32=.78125	25/64=.390625	57/64=.890625
11/16=.6875	27/32=.84375	27/64=.421875	59/64=.921875
13/16=.8125	29/32=.90625	29/64=.453125	61/64=.953125
15/16=.9375	31/32=.96875	31/64=.484375	63/64=.984375

Watt-second (Ws.)

The watt-second is a unit of energy or work, chiefly electrical energy or work, equal to one watt of power acting for one second. Put another way, a watt-second is equal to the work done when a current of one ampere is passed through a resistance of one ohm for one second. It is equivalent to one joule.

Notice that **one joule = one watt-second** and **one watt = one joule per second**.
See also Energy / Work.

Mensuration

Mensuration is the process of measuring geometric quantities.

Plane figures

Circle:

Let **C** denote the **circumference** and **A** the **area**. If **r** is the **radius** and **d** is the **diameter**.
Then:

$C = \pi d = \frac{1}{2}\pi r$ $\quad d = C/\pi$ $\quad A = \frac{1}{2}Cr = \pi r^2 = \frac{1}{4}\pi d^2$

Triangle:

Let **A** denote the **area**. If **a** is the **altitude** and **b** is the **base** then $A = \frac{1}{2}ab$

Quadrilaterals:

Let **A** denote the **area**. If **a** is the **altitude** and **b** is the **base,** or b_1 and b_2 are the bases of a **trapezoid**.
Then:

Quadrilateral	Area
Square	$A = a^2$
Rectangle	$A = ab$
Parallelogram	$A = ab$
Trapezoid	$A = \frac{1}{2}a(b_1 + b_2)$

Solid figures

The following notation will be used:

L = Lateral surface area	**V** = **V**olume	**r** = **r**adius of base or sphere
B = area of a **B**ase	**e** = lateral **e**dge or **e**lement	**a** = **a**ltitude
T = **T**otal area	**p** = **p**erimeter (or circum.) of the base	**s** = **s**lant height

Solid	Lateral Area	Total Area	Volume
Right Prism | Rect. Solid	$L = ep$	$T = ep+2B$	$V = Ba$
Cube	$L = 4e^2$	$T = 6e^2$	$V = e^3$
Right Circular Cylinder	$L = pa = 2\pi ra$	$T = pa+2B$	$V = Ba = \pi r^2 a$
Right Pyramid	$L = \frac{1}{2}sp$	$T = \frac{1}{2}sp+B$	$V = Ba/3$
Right Circular Cone	$L = \frac{1}{2}sp$	$T = \frac{1}{2}sp+B$	$V = Ba/3 = \pi r^2 a/3$
Sphere	$L = 4\pi r^2$	$T = L$	$V = 4\pi r^3/3$
Frustum	$L = \frac{1}{2}(p_1+p_2)s$	$T = L+B_1+B_2$	$V = a(B_1+B_2+)/3$

Force

A vector quantity indicating a strength or energy that tends to produce a change of motion or shape of a body in the direction of its application. The basic units of force are the dyne, the newton, and the poundal. See also Energy / Work.

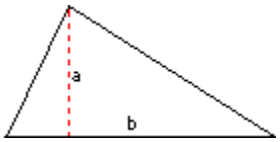
Circle

A closed plane curve consisting of all points at a given distance from a point within it called the **center.**

See also Mensuration.

Triangle

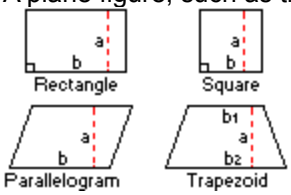
A closed plane figure having three sides and three angles.



See also Mensuration.

Quadrilateral

A plane figure, such as those shown below, having four sides and four angles .



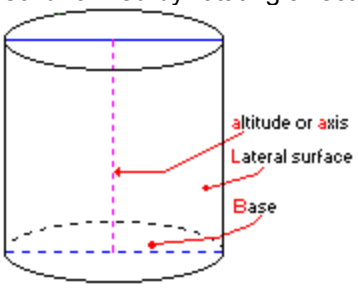
See also Mensuration.

Mensuration

The process of measuring geometric quantities such as area, volume, circumference, etc.
For more information, click here.

Right Circular Cylinder

A solid formed by rotating a rectangle about one of its sides as an axis.

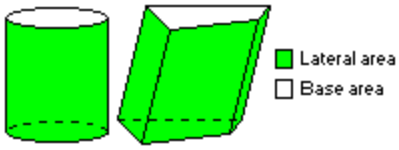


The bases are circles and the line between the centers of the bases is the cylinder's **axis**. Since the axis is perpendicular to the to the bases it is coincident with the **altitude**.

See also Mensuration.

Lateral Area

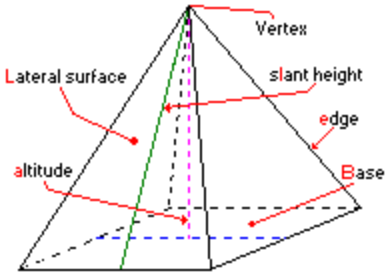
The surface area of the sides of an object not including its bases.



See also Mensuration

Right Pyramid

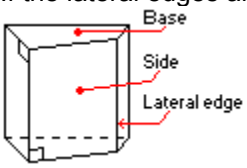
A solid whose base is a polygon and whose sides are triangles with their vertices at a common point known as the **vertex** of the pyramid. A **right** pyramid is a pyramid whose **base** is a regular polygon and the sides are equal isosceles triangles. The **altitude** is the line from the vertex perpendicular to the base. The **slant height** is the line drawn from the vertex to the center of one edge of the base.



See also Mensuration

Right Prism

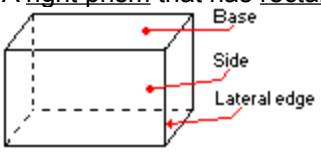
A prism is a solid whose bases are parallel polygons and whose sides are parallelograms.
If the lateral edges are perpendicular to the bases of the prism it is a right prism.



See also Mensuration.

Rectangular Solid

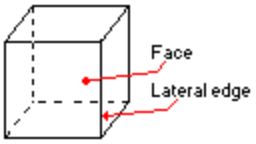
A right prism that has rectangular bases.



See also Mensuration.

Cube

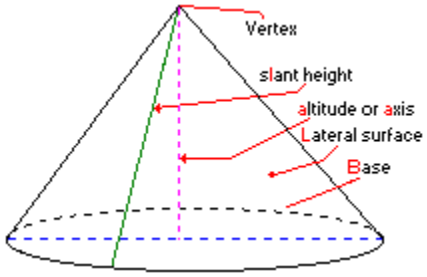
A rectangular solid where all six faces are squares .



See also Mensuration.

Right Circular Cone

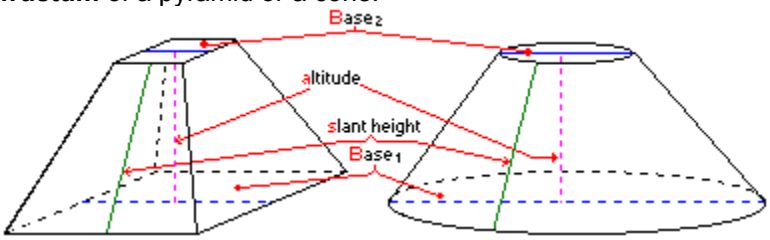
The **circular cone** is a solid whose base is a circle and whose lateral surface tapers to a point known as the **vertex**. The **altitude** is a line from the vertex to the base. In a **right** cone the altitude is perpendicular to the base. The **slant height** is the line drawn from the vertex to the circumference of the base.



See also Mensuration

Frustum

If the top of a pyramid or a cone is cut off by a plane parallel to the base the remaining part is called a **frustum** of a pyramid or a cone.



The **altitude** is the length of the perpendicular between the two bases and the **slant height** is the shortest line between the perimeters or circumferences of the bases.

See also Mensuration.

Sphere

A solid bounded by a curved surface, every point of which is equidistant from a central point.

A line from the center to the surface is called a radius.
See also Mensuration.

Multiplication Table

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
2	**4**	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38
3	6	**9**	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57
4	8	12	**16**	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76
5	10	15	20	**25**	30	35	40	45	50	55	60	65	70	75	80	85	90	95
6	12	18	24	30	**36**	42	48	54	60	66	72	78	84	90	96	10	10	11
																2	8	4
7	14	21	28	35	42	**49**	56	63	70	77	84	91	98	10	11	11	12	13
														5	2	9	6	3
8	16	24	32	40	48	56	**64**	72	80	88	96	10	11	12	12	13	14	15
												4	2	0	8	6	4	2
9	18	27	36	45	54	63	72	**81**	90	99	10	11	12	13	14	15	16	17
											8	7	6	5	4	3	2	1
10	20	30	40	50	60	70	80	90	**10**	11	12	13	14	15	16	17	18	19
									0	0	0	0	0	0	0	0	0	0
11	22	33	44	55	66	77	88	99	11	**12**	13	14	15	16	17	18	19	20
									0	**1**	2	3	4	5	6	7	8	9
12	24	36	48	60	72	84	96	10	12	13	**14**	15	16	18	19	20	21	22
								8	0	2	**4**	6	8	0	2	4	6	8
13	26	39	52	65	78	91	10	11	13	14	15	**16**	18	19	20	22	23	24
							4	7	0	3	6	**9**	2	5	8	1	4	7
14	28	42	56	70	84	98	11	12	14	15	16	18	**19**	21	22	23	25	26
							2	6	0	4	8	2	**6**	0	4	8	2	6
15	30	45	60	75	90	10	12	13	15	16	18	19	21	**22**	24	25	27	28
						5	0	5	0	5	0	5	0	**5**	0	5	0	5
16	32	48	64	80	96	11	12	14	16	17	19	20	22	24	**25**	27	28	30
						2	8	4	0	6	2	8	4	0	**6**	2	8	4
17	34	51	68	85	10	11	13	15	17	18	20	22	23	25	27	**28**	30	32
					2	9	6	3	0	7	4	1	8	5	2	**9**	6	3
18	36	54	72	90	10	12	14	16	18	19	21	23	25	27	28	30	**32**	34
					8	6	4	2	0	8	6	4	2	0	8	6	**4**	2
19	38	57	76	95	11	13	15	17	19	20	22	24	26	28	30	32	34	**36**
					4	3	2	1	0	9	8	7	6	5	4	3	2	**1**

Squares are shown in **bold** type.

Let a = opposite side

$$\frac{a}{64} = \frac{3}{4}$$
$$64 \times \frac{a}{64} = 64 \times \frac{3}{4}$$
$$a = 48$$

Let c = hypotenuse

$$\frac{4}{5} = \frac{64}{c}$$
$$c \times \frac{4}{5} = \frac{64}{c} \times c$$
$$\frac{4c}{5} = 64$$
$$4c = 320$$
$$c = 80$$